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CABLE-RATE REFORM IN ENGLAND.

Not in a long time have the people of Great Britain been so stirred as they now are over the agitation which is being led by Mr. J. Henniker Heaton's call for a universal two-cent charge for international cable messages. This redoubtable member of Parliament has arrayed himself against the great commercial interests operating the international cables connecting Great Britain and America, and, with characteristic zeal and pertinacity, has brought to bear the heavy ordnance of his logic and some startling figures to back up his contentions as the champion of the non-users of the cable systems.

Mr. Heaton claims that the cable systems are in the hands of monopolists; that the cables are arbitrarily left in idleness for a third of the time, so that exorbitant rates may be charged, and that the service as at present conducted is available largely to those business interests which must make use of it whatever the rate. In his analysis of the use of the cable he discovers that ninety-seven per cent of all the messages are from business houses, and that public participation in cable service is very small indeed. The capitalization placed upon existing systems, he says, is out of all proportion to their worth, and he makes the additional statement that if all the cable systems at present in use were wiped out it would be possible to reconstruct the whole system between the British Isles and America for $30,000,000.

It is a fact that the public will give hearty support to anything which appears to cheapen the price of a service, the question as to whether the cheapened service can or will be used not entering very largely into the decision. It is not only the general public, however, which is interested with Mr. Heaton in piling up a great wave of protest, for he has the support and influence of prominent men and women, and it may be noted also that a number of the influential papers of both countries are giving him more than ordinary encouragement.

When the proposition was at first brought up, those in charge of the destinies of the cable companies were inclined to pooh-pooh the idea, regarding it as highly chimerical. This can hardly be considered a safe procedure, however, for the people have realized that public clamor sometimes brings direct results. If a universal penny-a-word cable rate were established, with its burden of deficit—which, under present conditions, appears inevitable—thrown upon the Government, the cable companies would appear to be serving the people at large with less generosity than they are even now credited; for if the rate be exorbitant now, it is borne by those who use the service, while any burden of deficit carried by the Government would become a tax on the whole people. It does not appear reasonable either

that a reduction to a penny a word would result in nearly so large a proportionate increase of common use as the projectors of this scheme have suggested, and the probability is that with a lower rate there would be a still greater monopoly of cable service on the part of business interests. It is all very well to say that commerce is throttled, but it takes more than the control executed by a few companies over sixteen cables to do much throttling.

The probability exists, of course, that with proper incentive and imperative necessity, the operation of the cable systems can be cheapened, and that in consequence of an increased demand, more continuous use can be made of the cables already in service. The prospect of adequate return upon a large investment may also influence the laying down of new lines of communication. Nothing is being done so well that it can not be improved upon. The only thing necessary is the expedient, and a decent and orderly procedure to secure its consummation. The cable industry has grown to vast proportions, and has required large expenditures of money, and those who originally invested took long chances of there ever being an adequate return. If there has been a monopoly, and if the rates have been higher than a reasonable return would seem to require in this direction, it appears reasonable to assume that a large tribute should be paid for the facility which has been developed. It is, of course, unreasonable to expect that the present conditions can continue indefinitely, for some time there must be an end to the exacting of unreasonable tariffs. If that point has now been reached, proper investigation will discover it, but the companies should, and, in all likelihood, will, resist any attempt by methods, confiscatory or otherwise, looking to a cheapening of service and an unprofitable end, whether the burden be borne by the Government or by the cable companies.

The proposition of government ownership of the international cable systems seems stupendous when the capitalization of the companies is reviewed. Between Great Britain, Germany, France and America there are sixteen working cables operated by six companies. The Western Union system is made up of the American Telegraph and Cable Company, with two cables; the Anglo-American Cable Company, with four cables, and the Direct United States Cable Company, with one cable. The Commercial Cable Company operates or controls seven cable lines—four of its own, two of the German Cable Company, and one land line for feeding the Commercial system. The other large transatlantic system is that of the French Cable Company, operating two cables—making up the quota of sixteen. The Mackay Companies, operating the Commercial Cable Company, has an authorized capital of $100,000,000; the American Telegraph and Cable Company, $14,000,000 outstanding; the Anglo-American Telegraph Company, a capitalization of $35,000,000; and the Direct United States Cable Company, a capitalization of $11,256,000. Adding in the capitalization of the Central & South American Telegraph Company, $8,000,000; the Mexican Telegraph Company, $3,000,000, and that of fifteen smaller companies operating international cables, the stock of which is largely held in England, amounting to $10,265,000, we have a total capitalization of $187,592,000. It is hard to arrive at a definite estimate of either the capitalization or value directly applicable to cable resources, because the capitalization of several of these companies is devoted also to land lines, real estate and other tangible assets. But the figures given are a close approximation of the magnitude of the problem involved.

The matter has not attracted the attention in this country that has been given to it abroad. When agitation such as this, however, gets away from reasonable restraint there is a possibility of unreason running rampant. The subject should be viewed in the broadest possible light, and intelligent publicity given to every phase, so that there may be no mistake made in arriving at a sensible conclusion.

THE NEW YORK STATE PUBLIC SERVICE COMMISSION REPORT.

The second volume of the report of the Public Service Commission for the First District of the State of New York on the work carried out during the first six months of its existence —the period ending December 31, 1907—gives some interesting information concerning the public-utility corporations included in the district under the commission's regulation. One of the points brought forward is that extension and improvement of transit facilities brings increased travel, apart from the natural increase in population. This means that as lines are carried into remote communities, and tributaries to main arteries penetrate into easy riding distances, the public automatically gets the riding habit. In Greater New York the statistics show that there was a daily average increase of 341,000 passengers in 1907, the whole year showing an increase of 124,505,734, including regular fare and transfer rides.

Four-fifths of the traffic conducted by the street railways of New York state is handled in the greater city. The number of passengers is almost equal to the entire number carried by the tramway systems of England and Wales.

One of the curious points noted is that on over 103 miles of electrically-operated surface lines and forty-four miles of horse-car lines, the average speed is seven-and-one-half miles an hour. This would appear to be pretty slow traveling, but it should be remembered that a large part of the traffic is in localities where passengers are picked up and dropped at every street corner for possibly four-tenths of the distance traveled, and that the stoppages are included in the over-all speed. The forty-four miles of horse-car lines is divided into several cross-town lines serving the various ferry terminal points, where for the amount of traffic and the short distance of the run it is not considered commercially practicable to install an expensive conduit system, such as is called for by the restrictive regulations in force in New York city against overhead construction.

Probably no city has suffered so much from transfer abuse as Greater New York, and this matter has been a bone of contention between the passengers and the railway companies for the last few years. When the proposition of universal transfers was first inaugurated there appeared to be a decided increase in the profitable traffic attracted to the lines. Very soon, however, the public learned to make the greatest possible use of the transfer system, and it is estimated that the abuse of the

transfer system has made deep inroads into the revenues of the railway companies. A careful study of these conditions on the part of the railway operators has apparently revealed some illogical concessions in the establishment of promiscuous transfer points, and an effort is now being made to eliminate these as far as possible. The cutting off of such privileges on several lines in New York city has recently led to considerable antagonism on the part of the riding public, and several hearings have been held before the Public Service Commission, with, in one case, a decision against the company and an order to re-establish the transfer privilege at the disputed point, and the consequent refusal on the part of the company to obey the mandate of the commission. This is an interesting situation, which will only be relieved by a painstaking process of law.

The report states that there are fifty-one transfer passengers to each 100 fare passengers in New York city. Notwithstanding the increase in transfers, however, the experts on the commission have figured that this has not been at the expense of the railroads. They estimate that this growth has not been provided for in the establishment of higher car-mile figures, but has increased the passenger miles, which has resulted in the uncomfortable overcrowding of the cars in use. This has been deduced from the fact that while the receipts per passenger declined from 4.14 cents to 4.04 cents, the number of car-miles increased only 3.8 per cent; while the number of fare passengers increased 5.2 per cent, and the number of all passengers 7.9 per cent. The result is an apparent increase in the average passenger car earnings from 25.58 cents per car-mile in 1906 to 25.89 cents in 1907.

TUNGSTEN LAMPS VERSUS ACETYLENE PLANTS.

Acetylene-gas apparatus comes into direct competition with electric equipment where small lighting plants are wanted, due to the low first cost of the former.

While acetylene-gas plants are more commonly confined to single buildings or private grounds, they are also designed for general public supply in an increasing number of small villages, where there is no other gas or electric service. An illustration of this latter fact may be noted in a certain state where fourteen acetylene-gas plants are now engaged in general public supply, though there was not a single public plant of this sort in the state seven years ago. Acetylene plants for either public or private use compete much more directly with electric apparatus than with ordinary gas equipments, because the capacities of these plants are so small that coal or water-gas appliances are not suited to the purpose.

At the start, the use of tungsten lamps reduces the necessary capacity of boilers, engines, dynamos and wiring circuits by sixty per cent, if the comparison is made with 3.1-watt carbon-filament lamps, on a candlepower basis. In other words, an electric plant for 1,000 candlepower in incandescent lamps, corresponding to 500 lamps of sixteen candlepower, requires only forty per cent of the capacity in generating apparatus and conductors for tungsten as for carbon lamps.

Even where only one lamp per lighting point is wanted, so that the full benefit of the higher efficiency of the tungsten filament can not be obtained, the twenty-five-watt tungsten lamp enables the capacity of the generating plant and line to be reduced fifty per cent below the requirements for fifty-watt carbon lamps.

Comparatively little competition exists between electric and acetylene-gas plants engaged in public supply, but the conditions of such competition may be noted. Probably the most common price for acetylene gas from public plants is $15 per one thousand cubic feet, though the price ranges from about $12 to $20, and it requires the best grades of open burners to yield eighteen candlepower on one-half cubic foot per hour, or forty candlepower on one cubic foot. At $15 per one thousand feet, the cost of acetylene gas is thus 1.5 cents per hour at the forty-candlepower burner, and 0.75 cent per hour at the eighteen-candle burner.

Though a forty-candle tungsten lamp is not a standard size for interior use, it will do as well for comparison as any other, and would consume fifty watts. At ten cents per kilowatt-hour, the energy for this fifty-watt lamp costs 0.5 cent per hour, and the energy for a twenty-candle, twenty-five-watt tungsten lamp costs 0.25 cent per hour.

For the hourly cost of the tungsten lamp alone, a list price of $1.50 and an average life of 1,000 hours may safely be taken, as the discounts will fully offset any probable shortage of this average life.

This basis gives 0.15 cent as the cost of the tungsten lamp itself per hour of use, and this sum, added to the above figures for the energy consumed in each lamp, amounts to 0.65 cent for the forty-candlepower size, and 0.4 cent for the twenty-candlepower, per hour, as the total cost.

With acetylene gas costing 1.5 cents per hour at the forty-candlepower burner, and 0.75 cent per hour at the eighteen-candlepower, or about twice the cost of equal illumination with tungsten lamps, the failure of acetylene plants to compete successfully with electric in public supply is very plain.

As to isolated plants, the argument for acetylene apparatus is low cost of light compared with the price of electric service. Calcium carbide, from which acetylene gas is made, costs $70 per short ton, or 3.5 cents per pound, in the cheapest form made for use in acetylene-gas generators, and five cubic feet of the gas per pound of carbide is a very favorable yield. It follows that 0.2 cent per cubic foot is about the minimum cost of acetylene gas, for carbide alone, and this makes no provision for interest on the first cost of the generating plant, or for labor, repairs and depreciation.

The bare cost of carbide is thus 0.7 cent per hour for the forty-candlepower burner consuming one cubic foot, and 0.35 cent per hour for the eighteen-candle-burner using one-half cubic foot.

Compared with the above total costs of 0.65 cent and 0.4 cent per hour for forty and twenty-candlepower tungsten lamps, respectively, when operated with current sold at the rate of ten cents per kilowatt-hour, and lamp renewals extra, the cost of the carbide alone is 0.05 cent more for the one-foot burner, and only 0.05 cent less for the one-half-foot burner, per hour of lighting.

INDEPENDENT TELEPHONE CONVENTION.

TWELFTH ANNUAL GATHERING, AUDITORIUM, CHICAGO, DECEMBER 1, 2 AND 3.

The twelfth annual convention of the International Independent Telephone Association was held at the Auditorium Hotel, Chicago, during the last week. A total attendance of several hundred representatives of independent companies of the United States and Canada was predicted, and the roster of the registration committee early confirmed this estimate of the complete attendance, representing "4,000,000 telephones and 17,000,000 exclusive users."

The first convention session proper was called to order in the banquet hall of the Auditorium Hotel on Tuesday morning by P. C. Holdoegel, of Rockwell City, Iowa, the acting president. Following the invocation by the Reverend Frank G. Smith, of Chicago, the welcome of the city of Chicago was extended to the Independent telephone men by George M. Bagby, assistant corporation counsel of the city administration, acting for Mayor Fred A. Busse, who, though scheduled for an address, was unable to be present. The response was tendered by R. D. Critchfield, president of the Wisconsin Telephone Association. His address was quite impromptu, taking the place of Dwight E. Sapp, of Mt. Vernon, Ohio, who was unable to fill the place accorded him on the programme, but in convincing and unmistakable terms Mr. Critchfield urged upon the city of Chicago consideration of telephone connection with the large proportion of Independent telephone subscribers in the state and vicinity. The report of the secretary, Joseph B. Ware, of Grand Rapids, Mich., was lengthy and detailed, and gave a comprehensive history of the Independent movement during the past twelve months.

The afternoon session was given over to a technical and practical conference, at which the papers read partook of an operating and traffic character contrasted with the business and financial aspects of the morning's meeting. The technical meetings were in charge of Gansey R. Johnson, of Columbus, Ohio.

The first paper presented was that of Roy Owens, of Columbus, O., on "The Telephone Engineer in His Relation to the Telephone Business."

"The three divisions of telephone engineering," said Mr. Owens, "are, planning, constructing and maintaining. It is not uncommon to hear engineers say that they wish to devote themselves to construction and not to maintenance. Some of these are apparently indifferent to the planning. In these respects they are not giving themselves credit for being complete engineers. The planning is the really vital part of a telephone engineer's duty. One reason why more plants have not shown the result of poor design is that the demand for telephone service in years past has tended to outrun the capacity of the plants, so that even a poorly laid out cable system has found practically all of its cable pairs called for. As time goes by, however, and subscribers are more difficult to procure, the need of more care in the laying out of the plant will become manifest.

"The cable distribution is the most costly part of an engineer's work. A local telephone company may stand or fall with its degree of success in getting cable into those parts of its exchange district where cable will be in demand. The multiple-cable distribution methods somewhat widen the narrower limits within which cable distribution is flexible. The subway and pole lines must be so far complete that there is little demand for their flexibility. The switchboard terminals and the subscribers' lines and instruments have a large degree of flexibility.

"Care should be taken to have the most economical balance between the outside capacity and the switchboard capacity, which means that the former should be somewhat more than the latter."

J. H. Ainsworth, general manager Home Telephone Company, Dayton, Ohio, discussed "Some Economies in Handling Maintenance Men." His company has introduced a feature of requiring the repair men to report upon a printed slip whether repairs made are of a permanent or temporary character, as it is not always possible for a single workman to effect repairs of a permanent nature. If the latter is the case, the repairman is instructed to report so, but after the trouble is permanently remedied each man is held to strict account for recurring troubles in his district.

"Maintenance Economies" was the title of a brief paper read by G. E. Bickley, of Waterloo, Iowa. Any reasonable expenditure made to conserve the operation of the equipment, material or apparatus of a telephone system, is an economy, he said. Mr. Bickley also indicated a plan of postcard report of line inspections made in the course of other business, and advised, as well, the special inspection of the right-of-way, locating by chart possible prospective troubles.

The paper of J. P. Boylan, of the Home Telephone Company, Detroit, Mich., on "Handling Trouble," was read by B. H. Brooks, chief engineer of the same company. Careful tests by operators were advised to anticipate the discovery of trouble by the subscriber, and the author described a card system of filing this class of records. In explaining the difficulty often experienced in attempting to ring out on a short-circuited line, the writer described a form of relay designed to be placed in the generator lead to the position. This relay has an inductive winding shunted by pure resistance. The latter path may be opened by the armature picking up when an undue current traverses the relay winding. Thus normally the combined paths represent low impedance until the heavy short-circuit current actuates the armature, leaving only the highly-inductive winding in circuit, and at the same time lighting a pilot lamp in view of the operator.

The technical session was continued in the evening, but on account of the small attendance the papers presented were abstracted by the authors.

Frank F. Fowle, consulting electrical engineer, read an interesting and classical paper on "The Economical Development of Toll Territory."

"The purpose of this paper, as the title suggests, is a consideration of the principal factors in building up and developing a toll plant on a dividend-paying basis. There are naturally two divisions of the subject, namely, the projection of an entirely new plant in undeveloped territory, and the development of a plant already in existence; but the latter division of the subject grows out of the first, and undeveloped territory will be assumed as the starting point. Were there no previous experience in the toll business to furnish guidance in laying out a new plant in undeveloped territory, it would be necessary to proceed with the utmost caution; in fact, the whole development would necessarily be experimental and would involve a large financial risk.

"It is found that the public demand for toll service occurs in such ways that certain laws may be formulated which will express mathematically or graphically the volume of message traffic which will occur on the average under any given or known set of conditions. The design of a toll system divides itself naturally therefore into two parts, first the predetermination of the traffic, and second the layout of a

plant which will provide the necessary facilities in the most economical manner; under the system of rates charged or to be charged it becomes apparent at once what portions of the proposed plant will be profitable at the outset, or, if the rates are not settled in advance, an estimate may be made of the plant charges and the operating costs to handle the traffic, as predetermined, upon which may be based a system of rates which will insure dividends from the outset."

Mr. Fowle had made a study of the traffic between different cities and towns, taking into account their population and the distance between them, under a fixed-rate schedule. It was found that the traffic volume in total messages per month in both directions between any pair of zones could be fairly represented by the formula:

$$T = .00022 \frac{P_1 P_2}{D^2}$$

where T = the total messages per month in both directions.
P_1 = population of either zone.
P_2 = population of the other zone.
D = distance between the zone centers, in miles.

The formula as written may be regarded as possessing sufficient accuracy for a development study. The range of distances and population in the instances upon which the calculations for the constant were based, was very large; no account was taken of the telephone development in the zones used for calculation, but it varied from something like one per cent up to eleven or twelve per cent, with an average of six to seven per cent.

Other formulæ were indicated for the determination of toll rates, revenue per message, etc., and a quantity of valuable cost and physical data was given. Mr. Fowle exhibited a number of interesting long-distance telephone plant load curves showing the distribution of calls throughout the week, the effect of a night half-rate on the service for different days, the relation between speed of service and circuit loads, etc.

Following his paper, Mr. Fowle was called upon to explain the action of loading-coils on a telephone line. In complying, he took occasion to discount the general fallacy that these coils introduce a condition of resonance into the circuit. On open construction the loading-coils are usually placed at the transposition points, about eight miles apart. On cables the distance varies from three-quarters of a mile to one-and-one-half miles. In some cases their interposition has the effect of increasing the transmission four or five fold, but this ratio of improvement decreases for the larger conductors.

George K. Gann, Lincoln Neb., in a paper on "Handling Long Distance Traffic," described the two recording methods most generally used and applicable to either large or small offices. These might be termed: (a) The direct ring-down method; (b) the order wire method.

"The direct ring-down method requires trunks from the 'A' boards in the local offices, terminating at the recording board in signals and jacks. These should be multipled in each position or section in offices where there are two or more. The method of operation is as follows:

"1. The subscriber removes the receiver from the hook, lighting the signal on the 'A' or local board.

"2. The 'A' operator takes one of the cords of an idle pair, plugs into the answering jack of the subscriber's line, and answers 'number.'

"3. The subscriber asks for 'Long Distance.'

"4. The 'A' operator takes the other cord of the pair, tests, and plugs into a jack of an idle trunk to the recording board and rings, thus lighting a signal on the same trunk at the recording board.

"5. The recording operator takes one of the cords of an idle pair, plugs into the jack of the trunk on which the signal has been received and answers, 'Long Distance.' She then secures and records the subscriber's call on a ticket and has it sent or carried to the proper line operator.

"The order wire recording method differs from the first in that the trunks to the recording board appear only in the 'A' and 'B' boards of the principal local exchange. Other local exchanges must secure connection with the recording operator by cutting in on the regular order wire to the principal office 'B' board, and asking for 'Long Distance.' The 'B' operator makes a trunk assignment in the usual way, establishing connection with a trunk to the recording board."

The technical and business sessions were continued during Wednesday and Thursday. On Wednesday evening the annual association banquet was held.

The Independent telephone convention was marked by an unusually fine array of manufacturers' exhibits on several floors of the Auditorium Hotel. Most of these occupied suites on the banquet-room floor, convenient to the convention hall. The exhibits included manual and automatic telephones and switchboards, wire, construction material, protective devices, batteries, conduit, tools and motorcycles.

The following exhibitors occupied hotel rooms or suites with complete expositions of their products:—

American Electric Telephone Company; Automatic Electric Company, Chicago; Century Telephone Construction Company, Buffalo, N. Y.; Chicago Telephone Supply Company, Elkhart, Ind.; Cracraft-Leich Electric Company, Genoa, Ill.; H. E. Cobb, Chicago; Frank B. Cook, Chicago; Corwin Telephone Manufacturing Company, Chicago; W. H. Couch, Boston, Mass.; Dean Electric Company, Elyria, Ohio; Duplex Metals Company, New York city; Electric Appliance Company, Chicago; Excelsior Supply Company, Chicago; Fibre Conduit Company, New York city; Fox & Borden Manufacturing Company, New York city; H. S. Green Battery Company; Holtzer-Cabot Electric Company, Brookline, Mass.; Illinois Electric Company, Chicago; Indiana Steel and Wire Company, Muncie, Ind.; Manhattan Electrical Supply Company, Chicago; Miller Anchor Company, Norfolk, Ohio; Monarch Telephone Manufacturing Company, Chicago; National Carbon Company, Cleveland, Ohio; North Electric Company, Cleveland, Ohio; Ohio Brass Company, Mansfield, Ohio; F. W. Pardee, Chicago; Pierce Specialty Company, Elkhart, Ind.; Homer Roberts Telephone Company, Chicago; St. Louis Malleable Casting Company, St. Louis, Mo.; Sterling Electric Company, Lafayette, Ind.; Stromberg-Carlson Manufacturing Company, Rochester, N. Y.; Swedish-American Company, Chicago; *Telephony*, Chicago; Vote-Berger Company, La Crosse, Wis.; Warner Electric Company, Muncie, Ind.; Westinghouse Machine Company, East Pittsburg, Pa.

Plan New Telegraph Company.

The revived plan of Chicago Board of Trade operators to establish an independent telegraph company and use independent telephone wires between Chicago, St. Louis and Kansas City, which was begun a year ago, is now again projected in the name of the People's Mutual Telegraph Company.

The promoter of the enterprise is W. S. Jackson, ex-president of the Chicago Board of Trade. An ordinance is asked of the City Council permitting the stringing of wires under the Metropolitan Elevated structure.

Electrification of Steam Railroad Terminals in Chicago.

The Illinois Central Railroad is not the only one making an investigation of the feasibility of electrifying its Chicago terminals. Since the agitation for the electrification of this railroad began a large number of other railroads entering the city have been quietly making more or less exhaustive studies of the problems as related to their lines.

The suburban residents along the Chicago, Rock Island & Pacific and the Chicago, Burlington & Quincy railroads are agitating electric service on these roads. The managements of these lines and of some others realize that it is a problem that will have to be faced in the near future. Since not only the patrons of the roads and their adjacent property owners, but the city authorities as well, have been determined to have the smoke nuisance produced by their locomotives abated, the success and economy of the electrification projects that have been carried out in the East have convinced the managements that electrification has advantages not only in satisfying the public clamor but in providing an efficient tractive power.

Aside from the Illinois Central Road these investigations have as yet been carried out very quietly. The manager of one of the western roads, which owns large terminals in the city, stated recently: "There is not the slightest doubt that the city will eventually pass an ordinance acquiring electrification of the railroad terminals. Such a measure could not with equity require electrification of freight terminals at this time, but would probably deal first with the passenger traffic. There are some roads which are in a fairly good position to electrify their passenger terminals when the proper time comes—the time when they know what the best system is." The purpose of some of these investigations is to find out which system, single-phase or third-rail, is best suited for their purpose. It is generally believed that the officials of at least one system entering Chicago were more in favor of electrifying its lines than the officials of the Illinois Central Railroad have been until recently.

The city authorities in considering this subject have referred to the corporation counsel for an opinion on the power of the city to produce the changes desired. The opinion has just been prepared and states that the city probably has no direct power to compel electrification of the steam railroads. However, it does have power to prohibit the use of steam as a motive power if it can be shown that its use is attendant with emission of smoke, soot, cinders or otherwise injuriously affects the public health, comfort or property so as to amount to a public nuisance.

At a conference held on November 30 between the city authorities and officials of the Illinois Central Railroad the progress of the work on the latter road was reported. Some fifty plats have been prepared of the trackage so as to enable the electrification project to be carried through with least interruption to traffic and with the best ultimate results. While the plans are being perfected and carried out the railroad has offered to equip its locomotives with oil or coke as a fuel so as to make them less objectionable to the public.

New York Electrical Society.

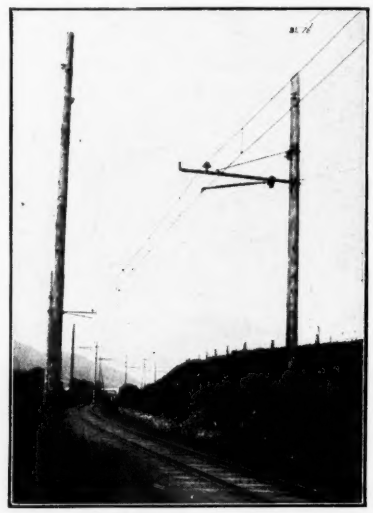
The two hundred and eightieth meeting of the New York Electrical Society, on invitation of the Electrical Testing Laboratories, was held at the laboratories, Eightieth Street and East End Avenue, Tuesday evening, November 24. Wilson S. Howell made a short address welcoming the society and explaining briefly the very wide range of work done by his company. While testing incandescent lamps is a very large part of their business, over 17,000,000 having passed through the laboratories last year, their work is by no means confined to testing incandescent lamps. Every possible design of lamp from the kerosene lamp to the latest development in arc lights is brought to them for test and measurement. All kinds of metals and composition material are tested, as well as measuring instruments of all kinds, shades and reflectors, insulators and insulating material; in fact, all material that goes into the construction of electrical apparatus is tested not only for the engineer and the manufacturer, but also for the purchaser. The point of Mr. Howell's remarks showing the wide range of their work was that the value of testing, both for the engineer and manufacturer, as well as the user of apparatus, is becoming more thoroughly appreciated.

Dr. Clayton H. Sharp gave a most interesting address, discussing apparatus for measuring spherical candlepower, the integrating sphere, methods of measuring illumination values, etc. After this address the members inspected the laboratories, where could be seen in operation every known form of testing apparatus. The members were also given a treat in the shape of an elaborate collation.

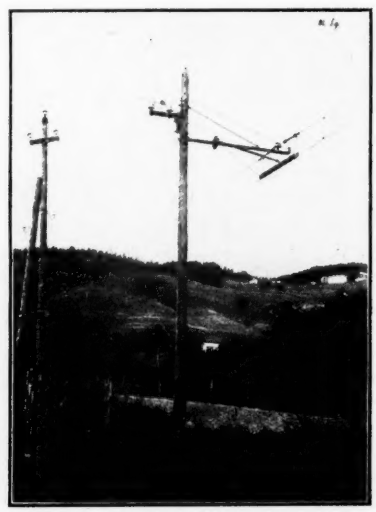
A NORWEGIAN SINGLE-PHASE RAILWAY.

BY A. WEBSTER.

For some time past, a waterpower electric generating station has been in operation at Skjenald Fossen, near Thamshavn, in Norway, its object being to supply Thamshavn and the villages en route to Lokken, where there are a considerable number of mines. The district is also one much visited by tourists, and electric power being available, it is not surprising that an electric railway between these two points should be thought of. Two gentlemen interested in the district accordingly went into the matter and finally decided to place an order with the British Westinghouse Electric and Manufacturing

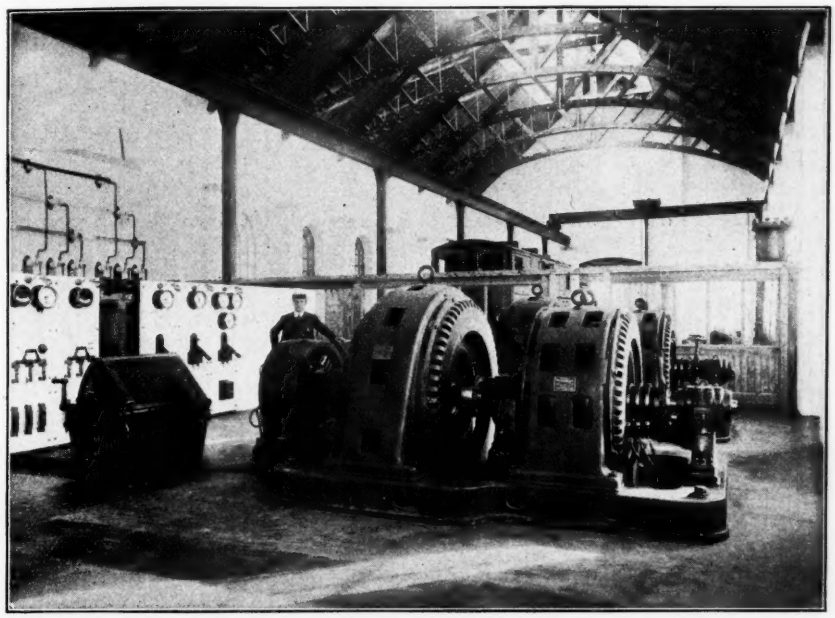


THAMSHAVN SINGLE-PHASE RAILWAY—OVERHEAD CONSTRUCTION ON CURVE.



THAMSHAVN SINGLE-PHASE RAILWAY—OVERHEAD CONSTRUCTION, SHOWING SECTION INSULATOR AND HIGH-TENSION SHORT-CIRCUITING SWITCH.

Company for the construction of a single-phase line. The order was placed and the line put into operation within twelve months, in spite of the climatic conditions prevalent during certain months of the year in this part of Norway. The line constitutes the first electric railway in Norway.



THAMSHAVN SINGLE-PHASE RAILWAY—MOTOR-GENERATORS IN SUBSTATION.

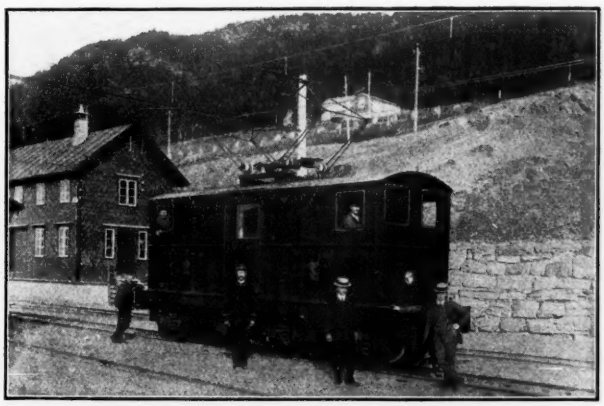
Thamshavn is some twenty miles distant from Trondjem, a well-known east-coast Norwegian watering place, and the railway is some sixteen miles in length to its other terminus at Lokken. The whole district is rich in minerals and timber, and so it is that arrangements have been made for dealing with large quantities of merchandise. In this connection there is a regular service of steamers between Trondjem and Thamshavn. The power station already mentioned is about five miles to the west of Thamshavn, and supplies three-phase current at 15,000 volts, fifty cycles, direct to the railway substation at Thamshavn, where transformation takes place to single-phase current at 6,600 volts, twenty-five cycles, for feeding to the overhead trolley wire. An interior view of the substation is shown.

Metre-gauge track has been laid, flat-bottomed steel rails being fastened to wooden sleepers laid on ballast. With the exception of double track and sidings at the stations, the line is single throughout, there being very few difficult gradients or curves to contend with for the greater portion of the way.

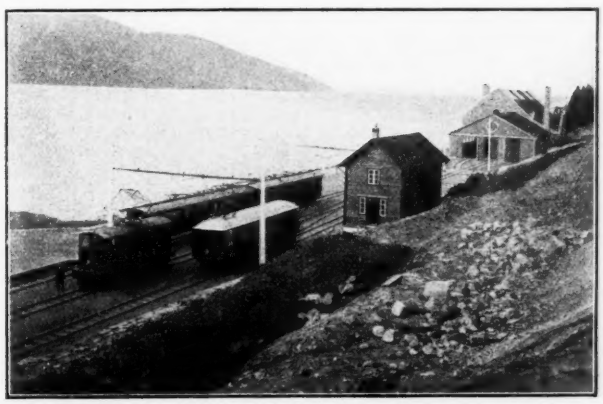
The overhead construction consists of hard-drawn, grooved copper wire of sixty-five square millimetres section, suspended from a steel cable. As will be seen from the photographs, the insulators supporting the steel cable are carried on steel brackets attached to wooden poles, the spans varying from 150 feet to sixty-eight feet, according to whether the track is straight or curved. The normal height of the trolley wire above the track is 5.5 metres.

A feature of the rolling stock is the provision of a motor coach for first-class passengers the interior of which is divided into a vestibule and driver's compartment at each end and two salon compartments with a lavatory between. This car is fitted with two forty-horsepower motors. The rolling stock also includes three twenty-ton locomotives, one of which is illustrated, for hauling the freight and passenger trains. Each of these locomotives carries four forty-horsepower motors, mounted on two trucks. Both on the locomotives and the salon coach the current is collected by a pantagraph bow and passes through an automatic circuit-breaker located inside the driver's cab. There the high-tension wiring is reduced to only ten feet in the case of the locomotives. The four motors are arranged permanently in two groups, two in series, cut-outs being provided, by means of which either pair may be isolated when desired. These locomotives are designed to exert a tractive effort of 6,500 pounds at ten miles per hour and a maximum tractive effort at starting of 8,000 pounds.

The substation forms part of the workshops at the Thamshavn terminus, and the plant installed consists of two 15,000 to 6,600-volt, oil-insulated, three-phase transformers and two 250-kilowatt motor-generators, capable of carrying an overload of 100 per cent for short periods. There is sufficient space, however, for an additional motor-generator to be installed. These units consist of a three-phase induction motor, fitted with slip-rings and liquid rheostat for starting, direct-coupled to a single-phase, revolving-field generator.



THAMSHAVN SINGLE-PHASE RAILWAY—TWENTY-TON SINGLE-PHASE LOCOMOTIVE.



THAMSHAVN SINGLE-PHASE RAILWAY—TERMINUS AT THAMSHAVN ON ORKEDALS FJORD.

PUBLIC SERVICE COMMISSION, FIRST DISTRICT, STATE OF NEW YORK.

SECOND VOLUME OF REPORT FOR SECOND HALF OF 1907.

The second volume of the report of the Public Service Commission, First District, State of New York, for the first six months of its existence, ended December 31, 1907, has been issued. From figures compiled from statistics presented by the companies under its control the commission states that the number of car rides per individual in New York in 1907 was 317; in 1902 was 266, and in 1890, 234.

The report shows that every extension and improvement of transit facilities brings increased travel quite apart from the natural increase in population. In the last seventeen years the passenger traffic has more than doubled. The total number of passengers carried by all lines in the greater city in 1907 showed an increase of 124,505,734, an average daily increase of 341,000 passengers. This includes regular fare and transfer passengers. The increase in the regular fare passengers was 65,778,979, or about 180,000 per day.

New York city, with one-half of the population of the state, accounts for four-fifths of the traffic conducted by the street railways of the state, which in turn is almost equal to the number of passengers carried by the entire tramway system of England and Wales.

The number of rides per capita in New York city (317 in 1907) is larger than in any other American city, with the possible exception of San Francisco, and greatly exceeds that of any city in Europe.

The street railroads of New York city embrace underground, elevated and surface systems operated by electricity and steam and horsepower. The underground system, known as the subway, which is owned by the city and operated by the Interborough Rapid Transit Company, embraced at the end of June, 1907, twenty-two miles of road in Manhattan and the Bronx.

The total length of roads operated by the railroads and street railroads under the jurisdiction of the commission aggregated 763 miles. As most of the line is double-tracked, and some of it laid with a third and fourth track, the total trackage is more than double the length of the road. Including sidings and turnouts and reducing all tracks to single-track mileage the total length of track was 1,612 miles.

In the borough of Brooklyn the total trackage of the Brooklyn Rapid Transit system is 564 miles, and that of other companies fifty-five miles. The borough of Queens, on all surface lines except the Brooklyn Rapid Transit system, has 147 miles, while the borough of Richmond has seventy-three miles of steam roads and sixty-two miles of electric roads. Omitting bridge trackage and combining the mileage of Manhattan and the Bronx, the length of road in these two boroughs amounts to 321 miles, as compared with 282 miles in Brooklyn, ninety-six miles in Queens and sixty miles in Richmond.

The new mileage put into operation in 1907 (nearly seventeen miles of track) was only a small part of the mileage under construction. Excluding the work done upon the new McAdoo and Pennsylvania tunnels, the companies already in operation expended $4,700,000 upon construction and reconstruction.

While the proprietary companies in 1907 charged to their capital accounts more than $2,000,000 for cars, the number of cars reported available for service was smaller than in the preceding year. The total number of cars available was 10,009, but not all of these are in service at any time, as more than one-quarter are of the open type, and used only in summer. The subway reports 794 cars; the elevated in Manhattan and the Bronx, 1,503; the surface lines in Manhattan, 3,280, and the surface lines in the Bronx, 786. The total number of all cars available in Brooklyn was 3,050; in Queens 313, and in Richmond 283. The Manhattan surface lines had 349 less cars in 1907 than in 1906.

The fluctuations of travel are shown in a table giving the number of passengers carried each year on the Manhattan elevated roads since 1892. In that year, the total number of pasengers carried by the elevated was 213,692,745. In 1893, it increased to 221,407,197, but from that year on there was a steady decline until in 1899 the total was 174,324,575; an increase then set in and continued up to 1904, when the total was 286,634,195. Here another decline set in and the travel decreased until 1906 when 257,796,754 passengers were carried. In 1907 the figures showed 282,924,273.

The report says the decline from 1893 to 1899 is explained by the extension of the surface lines and the improved service they rendered by reason of the substitution of electric for animal traction. The second decline in 1904 was due to the opening of the subway, which took a great many passengers from the elevated, but in two years the elevated roads recovered virtually all the lost ground.

Transfers are shown to have increased during the year 1907. While the number of regular fare passengers showed an increase of 5.2 per cent, the number of transfer passengers increased 18.9 per cent. The smallest percentage of transfer increase was in the Bronx (5.6 per cent) and the greatest increase in Richmond, where the number of transfers nearly doubled. Of the total increase in transfer passengers, namely, 58,700,000, Brooklyn furnished seven-tenths, yet the use of transfers in Brooklyn is still less than that on the Manhattan surface roads. Of the latter there are fifty-one transfer passengers to each 100 fare passengers, while in Brooklyn the ratio is only thirty-five to 100, but in Brooklyn, the figures include both elevated and surface roads.

Military Telegraphers Dine.

On the evening of November 27 the Old-Time Telegraphers' Association and the Society of the United States Military Telegraph Corps tendered a banquet to Andrew Carnegie, to bid him Godspeed and celebrate his seventy-first birthday. The banquet was held at the Manhattan Hotel, New York city, and four of the original members of the United States military telegraphers who responded to the call by Mr. Carnegie on April 22, 1861, for operators, were present. These were Col. William Bender Wilson, Richard O'Brien, Jesse W. Crouse and David Homer Bates. There were twenty-six other veterans of the Civil War Military Telegraph Association present, together with a couple of hundred members of the Old-Time Telegraphers' Association. Col. Robert C. Clowry, president of the Western Union Telegraph Company, presided, and addresses were made by Thomas A. Edison, W. C. Brown, William R. Plum, Richard O'Brien, Mr. Bates, Colonel Wilson, William J. Dealy, Charles P. Bruch and Col. A. B. Chandler.

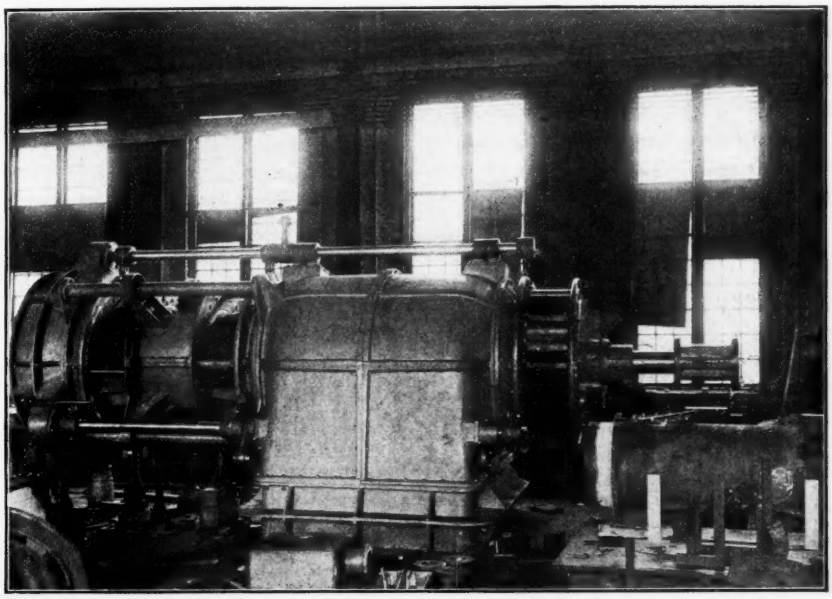
In closing the speech-making, Mr. Carnegie delivered a characteristic address, and expressed his appreciation of the tribute paid him by his old comrades.

After songs by Miss Leila L. Morse, granddaughter of Prof. Samuel F. B. Morse, inventor of the telegraph, all joined in this song to the tune of "Auld Lang Syne:"

God grant our honored guest the peace
His life has fairly won.
And crown him with Thy blessings,
For the noble deeds he's done.
'Tis not a nation, but the world,
To him should grateful be.
Oh, may he live yet many years,
Sustained by "Seventy-three."

Hydraulic Turbines at Priest Rapids, Washington.

The photograph reproduced herewith shows as it appeared during construction one of the vertical triplex Allis-Chalmers hydraulic turbines for open flume which has been installed at Priest Rapids, east of North Yakima, Wash., for the Hanford Irrigation and Power Company. This company is a Seattle corporation and has lately completed the work of building and equipping a new power house on the Columbia River at the rapids mentioned. This development has a present capacity of 2,000 horsepower, which will eventually be increased many times over. The irrigation project in connection with it embraces 16,000 acres of land and has a capacity for watering another 16,000 acres with a small addition to the present equipment. The company has also completed a pumping station at Coyote Rapids on the Columbia River, fourteen miles below the Priest Rapids, and has already in service transmission lines for electric power from Priest Rapids to this station.



VERTICAL TRIPLEX TURBINE FOR OPEN FLUME, EIGHTEEN TO THIRTY FOOT HEAD; CAPACITY, 1,000 TO 2,100 HORSEPOWER—HANFORD IRRIGATION AND POWER COMPANY, HANFORD, WASH.

The entire equipment for the new plant was contracted for at one time and from one builder. The latter's engineers, in conference with H. K. Owen, consulting engineer, of Seattle, laid out the entire plant for a hydro-electric pumping station of the type best adapted to the local conditions. Vertical triplex hydraulic turbines are set in open flume, each direct-connected to a vertical Allis-Chalmers alternator, each set being designed to meet the following normal conditions: Fall fifteen to thirty-two feet, power 1,000 to 2,200 brake-horsepower, speed 150 revolutions per minute. At fifteen-foot head each turbine develops 1,000 horsepower, at full gate and with a speed of 150 revolutions per minute. The vertical alternators are rated at 900 kilowatts and wound for sixty-cycle, three-phase current at 2,300 volts. The governor used is of the Allis-Chalmers oil-pressure type.

An exciter turbine and direct-connected generator is installed, designed to operate under twenty-one-foot fall, with a discharge of fifty-two cubic feet per second, and rated at 100 horsepower. A motor-generator exciter set of small capacity has also been provided. The transmission line mentioned above carries the current from the main station fourteen miles at 22,000 volts. This line is supported by eucalyptus pins and the cross-arms used were boiled in oil. The wires are arranged in a triangle. The poles are thirty-five feet high.

The pumping equipment consists of four single vertical-shaft suction pumps with thrust bearing. Two units have a capacity of fifty-two-and-one-half cubic feet each per second, against a total head of thirty-four feet. Their speed is 175 revolutions per minute and the diameter of the suction and discharge nozzles is thirty inches. These pumps are direct-connected to 450-horsepower Allis-Chalmers induction motors. The water is admitted at the bottom of the pump and the discharge casing is of the snail-shell type. The complete casing rests on three feet securely bolted to the foundation and held rigid. The remaining two pumps are of the same general type for high-lift service; each has a capacity of thirty-six cubic feet per second, against a total head of eighty-one feet and operates at a speed of 514 revolutions per minute. These pumps are direct connected to 550-horsepower induction motors. The bilge pumps are of the vertical motor-driven centrifugal type. They have bottom suction and open impeller. Direct-current, 110-volt, fifty-one-horsepower compound motors are used to drive them at 850 revolutions per minute. These pumps have a capacity of 150 gallons per minute against a thirty-five-foot head.

Proposed German Tax on Electricity and Gas.

The *Elektrotechnische Zeitschrift* of November 12 is accompanied by a supplement, which contains a reprint in full of a bill just introduced in the German Reichstag and having for its purpose the establishment of a tax on electricity and gas. It is proposed to levy a tax of five per cent on the selling price of electric current, with a maximum of 0.4 pfennig per kilowatt-hour. Current generated for private use is to bear a tax of 0.4 pfennig per kilowatt-hour, with a reduction to five per cent of the cost of production, when it can be proven that the above rate is in excess of this percentage. Gas is to bear the same rate of taxation per cubic metre of gas sold as the kilowatt-hour of electricity. Electrical installations of not over one-and-one-half kilowatts capacity are to be exempt from taxation. If the product is imported from a foreign country, the receiver is to pay the tax; if it is exported, the exporter is to pay the tax. All electrical illuminants, as well as incandescent bodies for gas, alcohol and oil lamps, are also to bear their burden of taxation. On the basis of statistics appended to the bill it is estimated that the net revenue to the German Government from this source will be about fifty million marks annually. The statistics show the number of generating stations existing in Germany in 1907 to be 1,530, with a capacity of 858,841 kilowatts and connections of a value of 1,100,861 kilowatts. The average cost of generating a kilowatt-hour in 1906 was 12.91 pfennig, and the average receipts per kilowatt-hour were 28.29 pfennig. The available water-power in Germany is stated to be 1,931,000 horsepower, of which 490,100 horsepower, or about twenty-five per cent, is now being utilized.

SMOKELESS COMBUSTION.

BY CHARLES L. HUBBARD.

So much has been said of late in regard to smoke abatement that a review of the subject may be of some interest and of practical value to those in charge of power plants which are located in or near large villages and cities.

It is probably true that comparatively few firemen in charge of the average plant are familiar with the nature of the chemical actions which take place in the boiler furnace during the process of combustion. While such knowledge is not absolutely necessary in order to avoid the formation of smoke, an understanding of the elements of any process is always the first step in successfully carrying on the same, whether it be the manufacture of some article, the running of a machine, or the burning of coal under a boiler.

A careful investigation of the matter of smoke consumption as reported by various experts lays particular stress upon firing and furnace construction, and these will be taken up briefly along the lines especially affecting the formation or prevention of smoke.

First, let us consider the process of combustion without reference to where it takes place or to the nature of the fuel. Chemically speaking, combustion is the combination of oxygen with certain elements which produce heat and light. The substance with which it combines is called the combustible, or when combustion takes place in an ordinary furnace it is called fuel. The chief elements of a fuel are carbon and hydrogen, and the products of perfect combustion are water, which consists of two atoms of hydrogen and one of oxygen (H_2O), and carbon dioxide or carbonic acid, as it is usually called, which is a gas made up of one atom of carbon and two of oxygen (CO_2). In the process of combustion, as it takes place in a furnace, the oxygen is taken from the air which enters through the draft doors, and this unites with the carbon and hydrogen in the full, forming carbon dioxide and water.

In order to secure perfect combustion, oxygen must be present in just the right proportion to unite with the elements of the fuel, as stated above. If there is not a sufficient air supply, carbon monoxide (CO) will be formed instead of CO_2, and this greatly reduces the quantity of heat produced. For example, if a pound of carbon is converted into CO, it will generate 4,400 heat units, but if double the amount of air is supplied, CO_2 will be formed and 14,600 heat units will be given off, provided the temperature is maintained at the proper point. On the other hand, if too much air is supplied, it lowers the temperature below the point necessary for complete combustion, and so the results may be no better than when the air supply is too small.

When combustion is not complete, some of the hydrogen, together with the carbon with which it is usually combined (called hydrocarbon), may be distilled from the coal and not burned, or the hydrogen only in this volatile matter may be burned, leaving the carbon in the form of soot or smoke, to be carried off in the gases passing out of the furnace. Smoke is a sure evidence of improper combustion, but it does not follow that where there is no smoke combustion is perfect. The perfect combustion of coal in a furnace can only be effected by a sufficient supply of oxygen supplied under proper conditions. The most important of these are a high temperature and an intimate mixture of the air with the fuel.

Coal is a compound substance and may be decomposed by heat into several distinct constituents, but in combustion we deal principally with but two—carbon in the form of coke, and hydrogen, generally known as gas. These two elements practically contain the full heating properties of the coal. We say that when coal is thrown upon a fire it commences to burn, but before any burning takes place it is decomposed into its constituent elements. The gas, having been distilled by the heat of the fire, burns first by its chemical union with the oxygen of the air, forming water. The gas having been disposed of, the coke burns in a similar manner, forming carbonic acid.

In order to ignite a substance and keep it burning it must be heated to a certain kindling point and kept up to that temperature. While the gas is being expelled from the coal the latter remains at a relatively low temperature; no particle of solid coal can burn while gas is issuing from it. A lump of coal may, however, be giving out gas in one place while it has been expelled from another and the remaining coke has already ignited. Coke does not produce smoke in burning; this is only formed during the distillation of the gas. To support combustion it is necessary to maintain a temperature of at least 800 degrees Fahrenheit. At temperatures lower than this there can be no burning of the coal. It is common in furnaces to have a temperature of 3,000 degrees Fahrenheit and over, just above the bed of live coals on the grate.

The amount of air required by a pound of soft coal to completely burn it is approximately twelve pounds, or 150 cubic feet. The actual amount needed in practice depends upon the force of the draft and upon how thoroughly the air and the gases are mixed. Former practice with ordinary chimneys allowed twenty-four pounds of air per pound of coal. With improved draft and better grates this has been reduced to eighteen pounds, and where combustion tubes or steam jets are used above the fire fourteen pounds has sometimes been found sufficient. The disadvantage of using too much air is the cooling of the fire, which retards combustion and reduces the transmission of heat, and second, the reducing of the chimney draft by cooling the stack. Every extra pound of air has to be heated by the fire, and this heat passes up the chimney without being used.

The quantity of air, however, should vary with the condition of the fire. Just after firing, when the gases are being distilled rapidly from the coal, more air must be admitted; after the coal becomes incandescent a comparatively small supply is needed.

The object to be attained in smokeless combustion is to prevent the formation of smoke rather than to provide means for burning it after it has been allowed to form. That smoke can be burned if carried into a very hot chamber and brought in contact with a sufficient quantity of highly heated air may be shown by the following simple experiment: First, place a short piece of candle inside of a tall narrow cylinder. The deficient air supply which the candle receives under these conditions will cause it to give off a column of black smoke. If this is led into the central draft tube of a Rochester kerosene lamp and passed up into the flame it will be completely burned.

The action of combustion and the effect upon it of different conditions is well illustrated by a kerosene lamp, and although this example has often been made use of, it may well be repeated in the present case. If we take a lighted central draft lamp and adjust the wick to such a point that it gives a rather short and clear white flame without a trace of smoke, then gradually obstruct the opening at the bottom, the following result will be observed: First, the flame will grow longer

and its color change from white to yellow, and then to red, and it will also begin to smoke. Finally, when the air supply is nearly shut off the flame will rise almost to the top of the chimney, at the same time giving off a column of dense black smoke and soot. In this example the wick represents the automatic stoker, supplying fuel automatically; the perforated gauze at the base of the burner is the grate which heats and regulates the air supply, while the chimney regulates the force of the draft. The smoky flame caused by turning up the wick is analogous to that caused by adding too much coal at one time to a furnace. If the supplies of air and fuel are properly adjusted to each other the flame will burn clearly and steadily without a trace of smoke. If on the other hand the wick remains the same and the chimney is raised from the base, smoke will again appear, because cool air rushing in above the gauze checks combustion by cooling the flame. If a cold metal rod or strap be passed down the chimney into the flame it will become coated with soot, due to the chilling effect upon the burning gases. In like manner, too close proximity of a crown sheet to the fire causes soot in a boiler furnace.

We see from the above that perfect combustion may take place rapidly with a short flame and slower with a long flame; also that imperfect combustion takes place with a very long flame of a low temperature with the same amount of fuel, but with different results as regards the production of light and heat. The principles learned from these simple experiments with the flame of a lamp are of great importance in connection with the study of the action of boiler furnaces. Having become somewhat familiar with the process of combustion from its theoretical side, let us now apply the various results noted to the actual burning of coal in the furnace of a steam boiler.

Bituminous coal contains usually from fifty-two to eighty-four per cent of free carbon and from twelve to forty-eight per cent of hydrocarbons. When this is burned in a common furnace the coal is first heated and the hydrocarbon gases are driven off in such quantities that not enough heated air can reach them to give perfect combustion, and dense clouds of black smoke will escape through the chimney. A large amount of heat is thus lost until all of the hydrocarbons have been driven off, when the chimney will stop smoking and combustion become more perfect until a fresh charge of fuel is dropped on the hot coke, when the same performance will be repeated. This result is more evident as the volatile matter in the coal increases, hence bituminous coal produces large volumes of smoke, while anthracite gives off but little. The waste caused by a smoking chimney is due to the escape of unburned gases rather than to the carbon which appears in the form of soot and smoke, the latter being usually less than one-half of one per cent of the coal burned on the grate.

Let us suppose we have an ordinary flat grate of the old-fashioned type without stoker or smoke-preventing device of any kind. Let there be a clear, even fire, with plenty of air coming up through the grate to complete the combustion of the coke. The fireman opens each door in turn and covers the whole surface of the fire with a layer of fresh coal. Additional air is needed to supply oxygen for this sudden increase of fuel, but the stopping of the air passages by the fresh coal prevents even the usual amount from passing through the grate. At the time when air is most needed least is supplied, and dense smoke is the result. A similar occurrence takes place at the time of starting up a fresh fire after cleaning.

Now let the fireman when he comes to replenish the fire put in one or two shovelfuls, and that on one side, leaving the other side red and bright. Let him also open wide the damper and get a free draft, and if the fire shows signs of smoking, leave the furnace door open an inch until the smoke has burned off. The next time let him fire the other side in the same manner. Likewise when he cleans the fire let him do but one side of the grate at a time and build his new fire with one or two shovelfuls at a time, keeping it bright and clean.

To be a good fireman, one should possess a rudimentary knowledge of the principles of combustion, although such knowledge may be more of a practical than a theoretical nature. The fireman should be able to demonstrate his ability to put such knowledge to good use by firing skillfully, placing each shovelful of coal where it will give the best results; promptly filling every hole in the firebed through which cold air may find an entrance; keeping the fuel bed level and the firebox temperature up to a desirable degree by skillful use of the furnace doors, ashpit doors and damper. He should avoid unnecessary slicing, but at the same time keep the fuel bed sufficiently open for the free and even passage of air. He should also be able to tell the condition of the fire closely by watching the ashpit.

On the other hand, with the best effort the fireman may be unable to produce satisfactory results as regards smoke because he is given too much to do; that is, in a large plant a man may be given too many furnaces to feed, and in a small one he may be given other duties that interfere with handling the fires in a proper manner. A case was reported some time ago where satisfactory conditions as to smoke production were brought about by reducing the grate area cared for per man from seventy-five to forty-seven square feet each in the case of hand-fired furnaces.

[To be continued.]

Westinghouse Directors Elected.

At the meeting of the Westinghouse Electric and Manufacturing Company held at East Pittsburg, November 30, the stockholders took final action prior to the termination of the receivership.

Resolutions were passed amending the by-laws of the company so as to allow the election of sixteen directors and to provide for the election of a proxy committee. The following board of directors was elected: For the class whose term expires July, 1909, Richard Delafield, E. C. Converse, Anthony N. Brady and J. D. Callery; terms expiring July, 1910, A. G. Becker, George M. Verity, William McConway and Charles A. Moore; terms expiring July, 1911, Charles F. Brooker, James S. Kuhn, Edward F. Atkins and E. M. Herr; terms expiring July, 1912, George Westinghouse, Neal Rantoul, Joseph W. Marsh and Albert H. Wiggin.

The election of a proxy committee resulted as follows: James N. Jarvie, Jacob H. Schiff, Charles Francis Adams, Robert S. Smith and F. W. Roebling.

Indiana Electric-Light Men Organize.

A large number of managers, superintendents and owners of electric-light plants in Indiana held a meeting at the Denison Hotel, Indianapolis, November 26, and formed the Indiana Electric Light Association. Thomas McReynolds, of Kokomo, was elected president, and Frederick Leslie, of Muncie, secretary and treasurer. The purposes of the association are defined to be educational, making for the discussion of scientific, experimental and electrical subjects. The members of the association are sanguine that sufficient interest will be taken in the associaton to make it a success, and believe the meetings for the exchange of ideas and methods of operation will prove helpful to electric lighting throughout the state.

QUESTIONS AND ANSWERS.

AYRTON UNIVERSAL SHUNT.—In the answer to the query of M. A. G., relative to the Ayrton Universal Shunt that was published in this column on November 14, a typographical error was made in the first equation. It should have been given thus:

$$\frac{I_g}{I_s} = \frac{s}{g + r - s}$$

The first member of the equation was unfortunately inverted. The equation is based on the principle that the currents in the two branches of a divided circuit are inversely proportional to the respective resistances. The subsequent equation, as previously correctly stated, is derived from this by the rules of proportion.

USE OF LEATHER BELTING.—Kindly advise me as to which is the proper side of a leather belt to be placed against the pulley face.—R. E. B., Carthage, Mo.

The two surfaces of a leather belt are called the flesh side and the grain or hair side. The latter is harder but not as strong in tensile strength as the former. For both these reasons the grain side should be placed against the face of the pulleys. Being a harder surface it is better adapted for the wear of attrition. At the same time the flesh side being much stronger, is better adapted to withstand the greater tensile stress to which the outside of the belt is subjected.

INDUCTION MOTORS.—1. Can the stator of a three-phase induction motor be connected delta? 2. If some of the copper bars are grounded through faulty insulation, what effect will it have on the rotor? 3. If current lags or electromotive force lags on a three-phase induction motor, will it cause fuses to blow? The motor generally runs from no load to twenty-five per cent overload, the fuses being heavy enough to carry forty per cent overload.—T. J. S., Dixon, Ill.

1. The stator may be either delta or Y-connected. 2. In the rotor the difference of potential developed between the conductor bars and the laminated core is very small, since the entire rotor, both copper and iron, acts as the secondary of a transformer. In the squirrel-cage type, moreover, the copper bars are entirely short-circuited by the end rings, so that the grounding of a few of them would produce little, if any, effect. In a rotor having an auxiliary resistance the grounding of a few bars might short-circuit some or all of the resistance so as to lose the value of the latter in keeping down the starting current. 3. The current in an induction motor invariably lags, but this should not cause any fuses to blow in normal operation unless the angle of lag is excessive on a very heavy overload. In this case the current would become exceptionally large and might cause the opening of the fuses. In the case cited, if the power-factor is not immoderate, there will be no occasion for the blowing of fuse.

WIRING RULES.—1. The following formula has been used by the writer for a number of years in calculating the size of wire used in direct-current wiring:

$$A = \frac{I \times D \times K}{V},$$

where A = area of wire in circular mils, I = amperes on line, D = distance in feet, V = voltage, and K = 21.62, a constant for direct current. Recently an insurance inspector told me specifically "that it was at fault when applied to No. 14 or No. 12 B & S wire, claiming that in practice the actual drop was about three times the theoretical result. Is this formula incorrect, or can you suggest a better one?

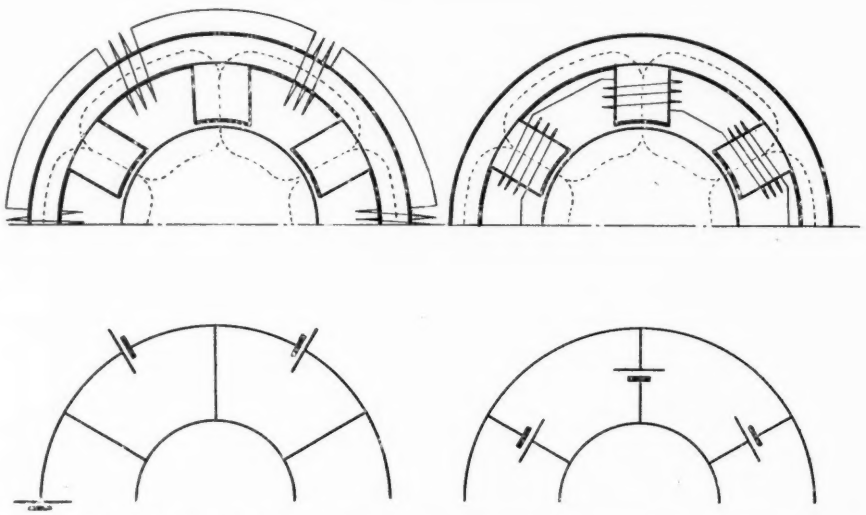
2. A certain architect's specifications call for "100 candlepower and 250 candlepower at each outlet—i. e., the size of wire and number of circuits to be large enough for the above candlepower lamps to be used." What authority will govern the interpretation of these words? For instance, if tungsten lamps are used in place of carbon-filament lamps, there is a difference between one-and-one-fourth and three-and-one-half watts per candle, with a corresponding difference in the number of circuits and size of wire. If the circuits were filled up to the capacity of 660 watts with tungsten lamps, would this be necessarily hazardous or against the National Code?

3. Kindly calculate for me the voltage at the last lamp on a two-wire circuit 100 feet long having twelve sixteen-candlepower, three-and-one-half-watt lamps connected to it, when the voltage at the tablet board is 115 volts, direct current and No. 12 B & S wire being used. Also what would this voltage be, if No. 14 wire were used?—H. K., Harrisburg, Pa.

1. The formula is correct and applies to any copper wire carrying direct current, provided K has the value given and V is the voltage drop in the line. It is derived directly from the fundamental laws of resistance and is frequently given in different but substantially equivalent forms. Thus, in place of V in the denominator, PE is sometimes used, where E is the voltage at the receiving end and P the percentage of line drop; in this case K has a value 100 times that given.

2. Rule 21d of the National Electrical Code limits incandescent lamp circuits to 660 watts without specifying the type of incandescent lamps to be used. It is the general practice for inspectors to allow such circuits to be loaded up to 660 watts with tungsten as well as other such lamps. The only hazard there is in this practice is the danger of substituting carbon-filament lamps of nearly equal candlepower for the tungsten lamps; this would, of course, overload the circuit. This procedure would be very unlikely, however, since a person that has once used tungsten lamps would probably not go back to the use of carbon lamps.

3. Assuming the lamps to be uniformly distributed at a distance of eight-and-one-third feet from one another, and considering each lamp as taking one-half ampere, the voltage at the last lamp would be 113.97 when No. 12 wire is used and 113.36 volts when No. 14 wire is used.



ARRANGEMENT OF FIELD COILS AND ELECTRICAL ANALOGY THERETO.

DYNAMO FIELD DESIGN.—Which is the more effective position for the field coils of a multipolar dynamo, assuming they are to have in either case the same number of ampere-turns—placed on the poles, as appears to be the more general prac-

tice, or linking the yokes, as I have seen in the case of a few machines. The latter seems to me to be preferable, as I believe it makes possible a saving in the length of the turn, and, hence, the total field copper. The cross-section of the yoke is necessarily only one-half that of the poles; consequently, assuming the same number of ampere-turns per winding will produce equal flux values in either case (the total number of coils being the same in either arrangement), the length of the pole-turn must be $\sqrt{2}$ times the length of the yoke-turn. As the resulting difference in the respective windings would be $\sqrt{2} - 1$, or nearly forty per cent, it appears that this yoke arrangement of coils would effect a substantial saving.—V. R. L., Augusta, Me.

Given coils of the same number of turns and traversed by equal currents, that is, of the same ampere turns, and placed on either the poles or the yokes of the machine as contemplated in the query, the yoke arrangement of the coils will set up only half the flux which would be produced by the pole arrangement. It must be remembered that flux "flows" as a result of magnetomotive force after a fashion analogous to the electrical phenomena of Ohm's Law. With magnetic circuits of equal reluctance the greater the magnetomotive force the greater the flux. It will be noted that in each of the local magnetic circuits formed by the yoke, pole pieces and armature, there are two sources of magnetomotive force (coils) per circuit in the case of the pole arrangement, while there is only one magnetomotive coil in the yoke arrangement. Since in each circuit the coils are placed in series cumulatively, having the same magnetic direction in each local path, the total magnetomotive force per circuit will be twice that of the yoke arrangement, and if the reluctances of the paths are equal the resulting flux will be correspondingly doubled.

An electrical analogy forms a convincing demonstration of this fact. In the electrical circuits shown the reader will detect an analogous relation to the magnetic paths, the coils or seats of magnetomotive force being represented by ideal cells (having no internal resistance) as seats of electromotive force. Considering the local circuits to be of equal resistance, a little examination will show that the currents which flow in the radial paths are twice as great in the "pole" arrangement of cells as in the "yoke" arrangement. Carrying back the analogy of current to flux, it will appear that there would be no theoretical gain but a fifty per cent loss in the yoke arrangement, while the mechanical disadvantages of putting the coil in this position are very great. As the inquirer says, the field yoke need be only half the area of the pole from magnetic considerations if the same quality of iron is used, but this relation is seldom given for structural reasons, since to gain stiffness the yoke or frame, made of a cheaper material of lower permeability than the poles, is given a comparatively large cross-sectional area and perimeter. Moreover, the magnetic leakage with the tangential coil arrangement is nearly twice as great as that with the radial coil design. For all these reasons the latter is almost exclusively used.

Relation of Current and Potential.—In the article on "Alternating Currents and Their Applications" the diagram, Fig. 16, on page 687, shows the current curve, which is dotted, as leading the impressed electromotive-force curve 1TS. Kindly inform me whether this can be correct for the supposed inductive circuit?—A. J. S., Indian Head, Md.

In the diagram referred to the axis OX represents time as measured from the point O as origin. The curve 1TS is further to the right than the corresponding half of the dotted current curve, and therefore leads the latter as it should. The electromotive force in this case leads the current by about twenty-seven degrees.

To Honor Wright Brothers.

In recognition of the achievements of the Wright brothers in their record aeroplane flights in France and this country, the Aero Club of America is now obtaining designs for two gold medals, which will be presented to Wilbur and Orville Wright at a banquet to be given in their honor early next year. President J. C. McCoy has appointed a committee to raise subscriptions from the 300 club members. The medals will cost about $1,000 apiece.

DeWitt C. Morrell is chairman of the Medal Committee, and the other members are Prof. Alexander Graham Bell, Peter Cooper Hewitt, Gutzon Borglum, Major B. Hersey, Charles J. Glidden, Christopher J. Lake, Octave Chanute, James Means, Albert F. Zahm, Charles M. Manly and Alan R. Hawley.

Invitations will be extended to all of the affiliated aero clubs in the country to send representatives, and an effort will be made to obtain one or more foreign delegates for the dinner.

Wilbur Wright has already received medals in honor of his notable flight from the Aero Clubs of France and Great Britain.

Hydraulic and Electric Machinery.

In his presidential address, given before the Yorkshire students of the Institution of Civil Engineers at Leeds, A. Meysey-Thompson referred to the controversy as to the relative advantages of hydraulic and electric machinery for docks, and said that probably all light and fast-working machinery, with the exception of capstans which are only worked intermittently, was better operated by electricity. For all underground machinery, excepting capstans which are constantly employed, and all heavy appliances of a quick-working character, hydraulic power was more efficient. Until quite recently the hydraulic accumulator was operated by a steam engine working high-pressure pumps, but electrically-driven pumps are being substituted with advantage. On large docks the demands on the accumulator are constantly varying, and a few weeks ago he had timed an electrically-driven accumulator and ascertained that it started and stopped pumps of 130 horsepower thirteen times in ten minutes. As the service required that the pumps should not run more than ten seconds before delivering water after starting the motor, there must be considerable stress on the machinery in absorbing the momentum of a falling accumulator, and so frequently changing its direction. Several systems of electrical control gear to start against full load have been introduced, and most of these employ a small subsidiary motor of about one-half horsepower, controlled by the position of the accumulator, and so geared to the starter as gradually to cut out the resistances in the rotor circuit at starting. The author described a method which avoids the use of the subsidiary motor and electrical connections to the accumulator and has the advantage of enabling the main motor, of whatever power, to start under practically no load. The accumulator operates a small pilot hydraulic valve which controls both the electrical starter of the motor and a by-pass on the pump. At starting the operation is first to accelerate the motor gradually under no load by cutting out the resistances until full speed is attained, and afterward to bring on full load slowly by closing the by-pass on the pump. When stopping the by-pass is first opened, the load on the motor reduced, and then the electrical starter breaks the circuit. By this system both the electrical starter and the by-pass work in consonance, and in emergency the former can be cut out and the pump worked directly by the accumulator.—*Times Engineering Supplement (London), November 11.*

ALTERNATING CURRENTS AND THEIR APPLICATIONS.

BY EDSON R. WOLCOTT.

CHAPTER I. (PART IX).—CAPACITY AND INDUCTANCE.

ELECTROSTATIC INDUCTION.

Heretofore the electric current has been considered to the exclusion of the static charge. However, the latter is of considerable importance in alternating currents, especially where long transmission lines are used. As is well known, static charges of electricity, produced by rubbing glass with silk, or sealing wax with flannel, can be accumulated by means of electrical devices called condensers. A condenser consists essentially of two or more electrically conducting plates separated by an insulator, as shown in Fig. 29, where A and B represent two plates and X represents the insulator. If a positive charge, such as would be obtained by rubbing a glass rod with silk, be given to the conductor A, an equal quantity of negative electricity accumulates on B. This action is known as electrostatic induction as distinguished from electromagnetic induction, previously explained. It is the induction of electric charges and not currents. To be sure, these charges, being electricity at rest, become currents when suitably connected to conductors. For example, if the two sides A and B of the condenser illustrated in Fig. 29 be connected, the two charges neutralize each other.

THE CONDENSER.

A condenser usually consists of many layers of conducting and insulating material alternately arranged. Every other conducting plate is connected to one terminal and the intervening conductors to the other terminal.

The capacity of a condenser increases with increasing the area of the plates and with decreasing the distance between them. It also depends on the material of the insulator between the conductors; for example, being greater when glass is used than when only air intervenes, and still greater if mica is used to separate the plates. The unit of capacity is called the "farad," but this is so large that its one-millionth part, or the "microfarad," is the unit in common use.

A conventionalized condenser composed of a number of plates is illustrated in Fig. 30. This is made of many layers of mica and tinfoil.

EXAMPLES OF CAPACITY.

A telegraph, telephone or transmission line is a type of condenser, as is, indeed, every arrangement containing conductors separated by insulators. In the case of a conducting wire suspended on poles, the

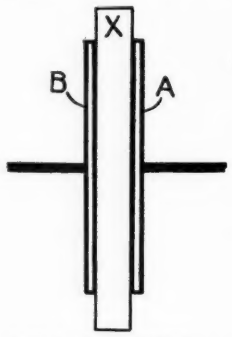


FIG. 29.—SIMPLE CONDENSER. A, B—CONDUCTING PLATES. X—INSULATOR OR DIELECTRIC.

wire itself forms one conductor and the earth the other plate of the condenser, the air between acting as the insulating medium. In the case of ocean cables the wire within acts as one conductor, the water as the other, and the insulation of the cable forms the insulating medium between. The capacity present in long ocean cables was one of the serious difficulties of their early operation, and its effects are by no means entirely eliminated at the present time.

CONDENSERS IN ALTERNATING-CURRENT CIRCUITS.

The electric charge produced by friction and electrostatic machines is of very high voltage, but is relatively small in amount. However, since the quantity of electricity accumulated by a condenser increases with the voltage, even with a

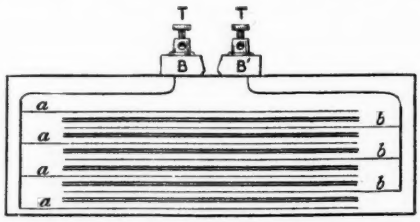


FIG. 30.—CONDENSER, ORDINARY TYPE (SECTION).

condenser of small capacity, considerable quantity may be stored up when a very high voltage is used. When a condenser is connected to an alternator each time the current changes direction the condenser charges and discharges. Thus an alternating current will flow in a circuit containing an alternator and a condenser, though with ordinary condensers the current is small. This is more clearly shown in Fig. 31.

Suppose at one instant of time the positive side of the generator is connected to A and the negative to D, a positive charge flows in AB in the direction of the arrow, producing the charges as shown in the condenser C. An equal positive charge is repelled along DE in the direction of the arrow. When the current changes direction the same phenomenon takes place except in the opposite direction. The negative charge could also be used to explain the above, as it may be assumed that a current of electricity consists of the flow of positive charge in one direction and a simultaneous negative charge in the other.

The effect of a condenser in an alternating-current circuit is such as to introduce another induced electromotive force, namely, that of the charge in the condenser and the characteristics of this are such that it tends to annul the induced electromotive force previously described, due to the changing magnetic field.

BALANCE OF INDUCTANCE BY CAPACITY.

In other words, the increased opposition to the flow of an electric current

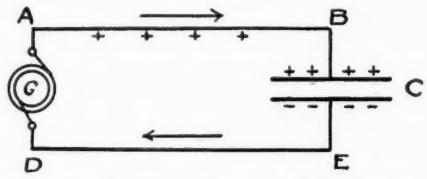


FIG. 31.—CONDENSER IN ALTERNATING-CURRENT CIRCUIT.

produced by the introduction of inductance in the circuit can be annulled by the introduction of suitable capacity in the same circuit. Suppose, for example, that a coil having a resistance of ten ohms and an inductance of 0.01042 henry be introduced into an alternating-current circuit having a frequency, f, of 127.5 cycles (these numbers are chosen so as to make the product $2\pi f = 800$, which is convenient to handle). In order to obtain a current of ten amperes in such a circuit an electromotive force of 130 volts will have to be applied, as shown in Fig. 32, where AC equals 100 volts, the product of the current by the resistance, and $BC = 2\pi fLI = 800 \times .01402 \times 10 = 83.3$ volts, the drop in potential over the coil. AB equals the resultant, or 130 volts, and is the voltage necessary to obtain a current of ten amperes. It may be obtained graphically. Thus, if AC = 100 units and BC = 83.3 units, then AB = 130 units, or $AB^2 = \overline{AC^2} + \overline{BC^2}$.

Suppose now that a capacity of 150

microfarads be introduced into the same circuit, as is shown in Fig. 33. Here G represents the alternating-current generator, L the coil and C the condenser. With the frequency, capacity and inductance as stated above, the last two bal-

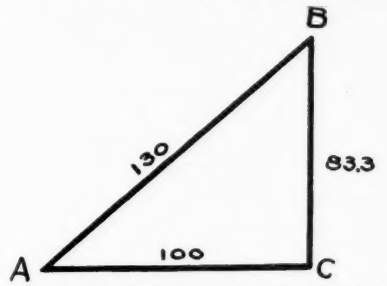


FIG. 32.—COMBINATION OF ELECTROMOTIVE FORCES.

ance each other exactly, and 100 volts applied at G gives just ten amperes. This is the same value that would be obtained if there were no inductance or capacity in the circuit. In other words, the potential drop over the condenser just balances that over the coil. Graphically

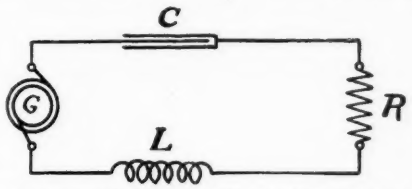


FIG. 33.—CAPACITY, RESISTANCE AND INDUCTANCE IN ALTERNATING-CURRENT CIRCUIT.

this is represented by Fig. 34, where BC represents the potential drop over the coil and CD represents that over the condenser; the two differ 180 degrees in phase, or are exactly opposite in direction.

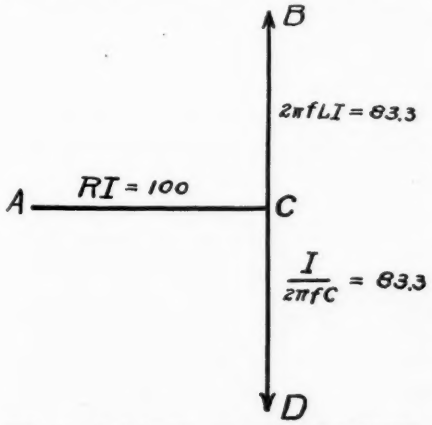


FIG. 34.—RELATION OF ELECTROMOTIVE FORCES FOR CONDITIONS OF RESONANCE.

The opposition offered by a condenser to the flow of an alternating current is inversely proportional to the capacity, for the greater the capacity the less the opposition; while with a coil, the greater the inductance, the greater the opposition. The capacity reactance of a circuit containing a condenser is therefore determined as $\frac{1}{2\pi fC}$, where C is calculated in farads. Thus 150 microfarads = .00015 farad.

$$\frac{1}{2\pi fC} = \frac{1}{800 \times .00015} = \frac{1}{.120} = 8.33$$

and the potential drop $10 \times 8.33 = 83.3$. This can be expressed algebraically as follows:

$$Z = \sqrt{R^2 + \left(2\pi f L - \frac{1}{2\pi f C}\right)^2}$$

where Z represents the impedance of a circuit containing both inductance and capacity.

ALTERNATING-CURRENT CURVES.

It has been assumed thus far in this discussion that the alternating-current curves are of the sine form first shown, but this is not always the case in actual practice. A very common wave form is

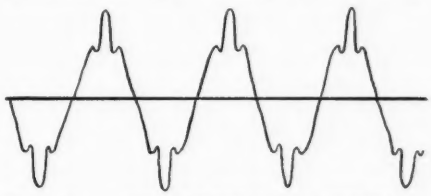


FIG. 35. — OSCILLOGRAM OF VOLTAGE WAVE FROM ALTERNATOR HAVING ARMATURE CONDUCTORS ASSEMBLED IN SLOTS.

that illustrated in Fig. 35, which was observed with an oscillograph, an instrument especially designed for this purpose, which will be described later. The fluctuations shown in this electromotive-force curve are due to the armature windings being placed in slots. The effect of inductance on this curve is to smooth it out, as shown in Fig. 36. Inductance in an electrical circuit acts like inertia in masses and tends to prevent sudden changes. Current through a condenser, on the other hand, magnifies the irregularities in the voltage curve, for any change in the electromotive force produces a rush of current into or out of the condenser. This is illustrated in Fig. 37, which represents the current produced by the voltage wave shown in Fig. 35 when applied to a circuit containing a condenser. A condenser resembles in some ways an elastic medium, in that slight vibrations may cause large disturbances. This is particularly true when the vibrations are accurately timed. For example, the trotting of a horse across a bridge has been known to set the bridge to vibrating to such an extent as to cause serious damage.

The application of the phenomenon of balancing capacity by inductance is now being worked out to remedy the defects of long-distance telephones, telegraph and submarine cables. The capacity of the last particularly is very great, and in-

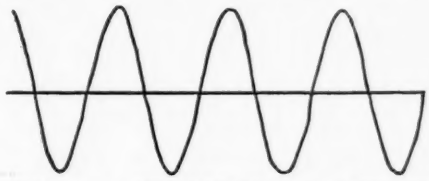


FIG. 36. — OSCILLOGRAM OF CURRENT CURVE PRODUCED BY SAME VOLTAGE WAVE IN CIRCUIT CONTAINING INDUCTANCE.

ductances, called "loading coils," are being introduced at certain distances to annul the condenser action.

TUNING ELECTRICAL CIRCUITS.

The proper adjustment of capacity and inductance for a given frequency finds many applications where currents of very

FIG. 37. — OSCILLOGRAM OF CURRENT CURVE PRODUCED BY SAME VOLTAGE WAVE IN CIRCUIT CONTAINING CAPACITY.

high frequency are used, such as in wireless telegraphy and other forms of high-tension discharge. The proper regulation of the value of condensers and the inductances is often called tuning from its resemblance to the tone adjustment of musical instruments. The phenomena observed in electrical tuned circuits are of very great interest, but rather too complicated to be considered here.

Northwestern Elevated.

John B. Dennis, of Blair & Company, has completed a plan for readjusting the Northwestern Elevated finances, including the issue of first-mortgage bonds at four and one-half or five per cent to take up the entire four per cent issue and possibly the new issue of preferred stock. The floating debt will be liquidated and provision made for development.

The first installment of electrical machinery for the Gatun handling plant for the Panama Canal has arrived on the Isthmus. It is expected that the plant will be in operation by July 1, 1909.

Cincinnati to Have an Electrical Show.

To show that it is wide-awake to the progress and rapid strides of the electrical industry, Cincinnati has planned an electrical show for next spring. The city has marked advantages of an industrial and commercial character, owing to its nearness to the sources of supply of the principal raw materials, its good transportation facilites and central location. These factors have created a demand for an exposition which will familiarize the general public with the practical applications of electricity. With this object in view the Western-Southern Electrical Show has been announced for the two weeks, March 13 to 27, 1909. About thirty per cent of the space has already been subscribed for and the success of the show is assured.

The representative character of this exposition is indicated by the personnel and standing of its directorate, among whom are: John L. Shuff; A. F. Chamberlain and J. A. Brett, Westinghouse Electric and Manufacturing Company; F. D. Lawrence, F. D. Lawrence Electric Company; J. D. Lyon; A. J. Conroy; M. E. Moch; Samuel Glover, Post-Glover Electric Company; J. E. Devere, Devere Electric Company; L. J. Van Lahr, Provident Savings Bank and Trust Company; L. J. Lowenberg, Reliance Engineering Company, and General Michael Ryan.

Alton Road Begins Motor-Car Experiments.

Officials of the Chicago & Alton Railroad have started on a demonstrating trip of the new Strang motor car. The experiments will continue for a period of three weeks. The method of propulsion of the car is electricity generated by a gasoline engine. The system consists of a gas engine with direct-connected generator, electric transmission and control between the generator and truck motors and a storage battery. By means of a starting rheostat the current is taken from the battery to the generator, which is converted temporarily into a motor for starting the engine. The fuel and ignition then being turned in, the engine and generator increase in speed to a point where the generator, acting as such, produces an electric current. When the car is standing still the current will go into the storage battery and be kept in reserve until such time as the motors require more current than is produced by the generator. The engine occupies the forward end of the car and the balance of interior space is devoted to a passenger compartment. The railroad is experimenting with the car both from the standpoint of economy and improvement in service between stations on branch lines.

The London Electric-Power Problem—Bulk-Supply Scheme Rejected.

After a hearing lasting fifteen days a committee of the House of Commons has rejected the bill which proposed the erection of a generating station having a capacity of 120,000 kilowatts to supply electrical energy in bulk to London and a large surrounding area. This decision is of much greater moment than may actually appear on the surface, for it is the application of a policy which if prosecuted to the fullest extent means the stifling of private enterprises in London, at any rate while the present Government is in power. The rejection of this electric supply scheme is undoubtedly a political decision, and one cannot help recalling the fact that for no less than thirty days a most influential committee of the House of Lords considered the same scheme in much greater detail than did the House of Commons and finally passed it in a somewhat modified form. The House of Lords committee included Lord Cromer, who was in charge of the administration of Egypt for so many years, and Lord Welby of financial fame, for many years chairman of the finance committee of the London County Council. But the House of Commons committee, presided over by a coroner, by the way, and consisting of members with no experience in large commercial undertakings or problems, has the final word in this particular instance, and so the scheme is dead. It is interesting to note the conflict of opinions between the political party which has undoubtedly wrecked the scheme and the actual opponents before the committee. On the one hand it is argued that such a scheme is wanted, but that it should be in the hands of the London County Council, and on the other hand it was urged that the present supply is ample for all purposes and that no bulk scheme is required.

This brings us back to the present position. Broadly, London has been parcelled out, for electric supply purposes, to a number of local authorities and companies. The latter hold their powers in perpetuity, while the latter are purchasable in 1931 by the local authorities of their respective districts. No local authority, however, may purchase anything outside its area, and knowing this limitation the companies have in many cases carefully set to work and erected generating stations outside the boundary, with the result that many a local authority is in the position of being able to purchase only the distributing mains. At the commencement of the present session of Parliament the companies brought in a bill giving them powers to link up the various generating stations so as to be able to use them with greater economy. A wise legislature in 1882 had put upon the companies the provision that they should not "associate," an absurd position of affairs which has remained in force ever since. As a *quid pro quo* for granting these powers the Government expressed its intention of inserting a clause in the bill substituting the London County Council the purchasing authority in respect of all the companies instead of the individual local authorities, and this would to a large extent get over most of the difficulties applying to the local authorities purchasing. For instance, practically one undertaking would then be in existence on the one hand. When the matter came before the same committee which rejected the bulk scheme, it was quickly realized that difficulties lay in the way. While on the one hand the London County Council had been constituted the purchasing authority for all the companies in 1931, it was suddenly discovered that certain local authorities had special powers of purchase at dates preceding this, and as the committee refused to take away these special powers the companies threatened to withdraw the bill. Having gone so far, however, the committee refused to allow this to be done, and what Parliament is pleased to call a comprehensive scheme is one over which some local authorities have purchasing powers before 1931, as to a portion, and the London County Council purchasing powers over the remainder after 1931. Furthermore, no provision is made for merging the undertakings of the local authorities into the larger undertaking when the County Council comes into possession, and unless some such arrangements are made the year 1931 will witness the London County Council in several portions of London competing with a small local authority electricity undertaking, and both the County Council and the local Borough Council will be representing the same ratepayers! Confusion is certainly becoming worse confounded the further the matter goes. A. W.

AN ENGLISH VIEW OF SOME TRACTION PROBLEMS.[1]

BY H. E. YERBURY.

Ordinary street traction has during the past ten years become standardized and improvements which have been made in electrical and mechanical details are of a minor character.

Series-parallel control with series motors appears to have fulfilled all reasonable requirements, and although the all-around efficiency may be improved in many cases, yet as long as the motors run without vigorous sparking and the cars maintain schedule speed, and the temperature of motors and bearings is not abnormal, and the cost of maintenance is fairly low, the average tramway manager is satisfied.

In respect to the economical generation of electricity, we can hardly expect—with the present price of fuel—that costs will be materially reduced, for about fifty-two per cent of the total generating costs are now expended in coal. Engineers of combined lighting and power stations should consider themselves fortunate in being able to obtain such a high price for current supplied to tramway undertakings, for the average price charged in Great Britain is 2.82 cents per unit, whereas in tramway power stations current can be generated and distributed at about 0.78 cent per unit, and including interest on capital, sinking fund, rates, taxes, insurance, etc., at a total cost of about 1.32 cents per unit. We may therefore reasonably expect in the near future to see a reduction in price to large consumers, such as tramway departments.

As what might be called commercial rather than technical knowledge often governs tramway administration and management, such considerations as the determination of the characteristic properties of tramway motors for the work they are often called upon to perform, and the plotting of efficiency curves of motors in order to get the greatest commercial advantage in working cars, are often ignored, and if drivers could be educated to work controllers and brakes in an efficient manner and utilize the kinetic energy, the resultant saving would, in the author's opinion, be at least equal to the results obtained by regenerative control, which, by the way, does not appear to have made the progress that was expected at the time of its inception, for it is evident, after comparing the relative efficiencies and advantages of series and shunt motors for traction work, that there is nothing to be gained by using shunt motors.

It speaks well for the stability of series motors when one finds that notwithstanding the diameter of carwheels has been increased two to three inches, canopy tops have been fitted, making cars some two tons heavier, and motors are now often used for ordinary service braking; yet the same motors which were designed for lighter work are well able to stand these onerous conditions. But we must expect that maintenance costs will increase, and in the author's opinion it will doubtless be necessary in the near future to install ventilated motors, possibly of the interpole type, to effectively meet the requirements of modern practice.

The trackless trolley system, which has for several years been in operation on the Continent with a fair measure of success, appears to offer advantages in the way of low capital and running costs, and the system generally compares very favorably with motor cars carrying their own power equipment. In the author's opinion there is a useful and remunerative field for a trackless trolley system in many districts, as the same overhead equipment could be retained if the population or requirements of a particular district justified the laying down of rails with a frequent service of cars after, say, a few years' running under above conditions.

In the early days of railway electrification three-phase motors were used, presumably for want of a better system, for it was then necessary to run two overhead wires for each track, yet this was proved to be more economical than laying heavy insulated steel rails on the permanent way as required for locomotives working with continuous current.

Now that single-phase motors are built that have the characteristics and large starting torque necessary for railway work, we may expect to see rapid progress in that direction. It has been demonstrated in many instances that, as a single-phase motor is nothing more than a direct-current motor with laminated fields so as to reduce the iron losses with alternating-current excitation, and fitted with a compensating winding for neutralizing armature action, these motors may be used for either system, and in the author's opinion should prove very useful for tramway and railway work in this country, for when run on a direct-current system, say for town or suburban service, the motors would have an efficiency of about eighty-eight per cent, and for linking up towns or cities the same cars and motors may be used with, say, a twenty-five-cycle single-phase current and give an efficiency of about eighty-three per cent. In such cases the single-phase system is economical, as energy can be transmitted at high voltage, and the capital and maintenance costs are low.

A problem which is engaging the minds of designers at the present time is that of building satisfactory direct-current turbo-generators of, say, 1,000 to 1,500-kilowatt capacity. With alternators no difficulties present themselves, for they can be readily designed suitable for the high speed required by turbine manufacturers, whereas for the comparatively low speed required up to the present for direct-current generators, steam consumption is invariably higher, and is brought down to a point practically equal to the steam consumption of reciprocating engines of equal power. Important developments and improvements have been effected within the past few years, and we now find that compensating windings and interpoles have been adopted for neutralizing reactance voltage and armature reaction, and radial commutators appear to have given good results, so that we may reasonably expect that brush and commutator troubles, with their high maintenance costs, will be minimized, and that carbon brushes will be universally adopted in the future. I think we may also expect to see great improvements in the general design and mechanical construction of turbines. It is well known that clearances in the past have been so fine and so closely calculated for a predetermined temperature of steam that either serious trouble or loss in efficiency has taken place when the temperature of steam has been raised or lowered, and to overcome this trouble combination turbines of impulse and ordinary blading design have been evolved. The true value of the latent heat of steam is now being fully understood and appreciated, and we may reasonably expect that turbines will be so designed in future that their efficiency will not be impaired by eliminating the very fine clearances which have been the primary cause of considerable trouble in the past.

[1]Abstracts from an inaugural address by the chairman of the Leeds local section of the Institution of Electrical Engineers, delivered at the University of Leeds, England, on October 28.

PRACTICAL CONSIDERATIONS IN THE SELECTION OF TURBO-ALTERNATORS.[1]

BY M. KLOSS.

Whenever a new invention is brought out, its development is to a certain extent retarded by the fact that people base their judgment of the new thing on their experience with old things, or, in other words, they measure it with the same scale they are accustomed to use without first considering whether this attitude is fair toward the new thing. It seems to me, therefore, the duty of all who take an active part in its development, to show that the supposed discrepancies are chiefly due to using the wrong scale, to provide the right scale instead, and to show the proper point of view from which the new thing ought to be looked at.

These considerations have often occurred to me when designing turbo-alternators, especially when reading specifications for such machines. Very often one finds conditions laid down in a specification which are simply copied from slow-speed alternators, where they are quite within the limits of commercial or physical possibilities, whereas, in the case of turbo-alternators, they may be impossible of fulfillment, owing either to mechanical reasons or to commercial considerations.

I, therefore, regard it advisable to investigate some of these points from a designer's point of view for the guidance of those who have to get out specifications for a turbo plant. This is the more important at the present juncture, as the various makers have now gained a more or less costly experience in manufacturing this new class of machinery, while, on the other hand, the demand for larger high-speed units is constantly increasing.

The three points with which I propose to deal in this paper are: Ventilation, voltage regulation, power-factor and its influence on the size of machine.

VENTILATION.

In old times (relatively to the electrical industry), nobody troubled themselves about the heat produced by a dynamo in the form of losses. However, when competition became keener and the theory of the design was better understood, the makers were driven to squeeze as much output out of their machines as they possibly could. The limit was then given by the heating of the machine. Now designers are not satisfied even when they have found out how to predetermine the heating under given conditions, but they are carefully studying the laws of ventilation with a view to improving this through proper design, or even by providing special means for insuring the most efficient method of cooling a machine.

It is well known that under otherwise equal conditions the output of an electrical apparatus increases approximately

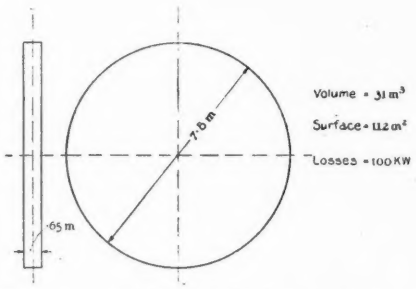


FIG. 1.—OVER-ALL DIMENSION OF LOW-SPEED MACHINE.

in proportion to its volume, or as the cube of its linear, while the radiating surface only increases as the square of dimensions. Hence there must be a limit of size where the surface is no longer sufficient to radiate the heat produced in the apparatus. This is the reason, for instance, why transformers above a certain output can only be built with artificial ventilation. As regards machines with moving parts we are much better off, because they produce, through their own motion, a natural ventilation, which helps to keep the machine cool.

The time is not far distant when we shall have to regard a scheme of ventilation for a turbo-alternator of large ca-

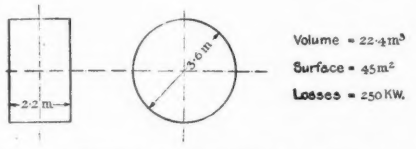


FIG. 2.—OVER-ALL DIMENSION OF HIGH-SPEED MACHINE.

pacity as a natural and essential part of the plant, just as one does the condensing plant for the steam portion. In order to make this quite clear, I give in Figs. 1 and 2 the overall dimensions of a slow-speed alternator for 2,000 kilowatts and for a turbo-alternator for 6,000 kilowatts. The total losses in the low-speed machine are about 100 kilowatts. However, the losses in the higher-speed machine are about 250 kilowatts, or two and one-half times as great as in the other machine. For every 100 kilowatt losses, therefore, there is only a volume of nine cubic meters available against thirty-one cubic meters in the large machine (that is, less than one-third), and the available surface is only eighteen square meters per 100 kilowatts against 112 square meters in the first machine (that is, less than one-sixth). I think these figures show clearly that it is quite necessary for the designer to provide special means for dissipating the heat which is generated in a relatively very small space. This is the more important, as the high peripheral speed at which modern turbo-alternators run is liable to produce noise, and in order to reduce this as much as possible one is bound to enclose the whole machine. The result is that the conditions of cooling by simple radiation and conduction to the surrounding air are made still worse.

The consequence of this is that makers must design the rotors so that, either by their own shape or by additional fans at their ends, they produce a strong draft through the machine. This seems to be now quite common practice, at all events with machines, say, up to about 3,000 kilowatts.

If, however, sets of larger capacity are to be installed, the user has to face the fact that rather large quantities of heat will be produced in a comparatively small space, and it is quite a serious problem to consider beforehand what he is going to do with this energy. For instance, in a power station where it is intended to install six turbo sets of 6,000 kilowatts each, the amount of heat produced by these six sets running at the same time will be something like 1,500 kilowatts, without allowing for the heat radiated by the steam turbines. If this great amount of energy were allowed to go into the engine room without special provision for dispersing it, it would not be surprising to find the temperature in the engine room rising rather rapidly to a point which would make it impossible for men to stay in the room.

The heat created in the room can escape only in two different ways: A portion will be conducted and radiated by the walls, the roof, and the floor; and another portion will disappear by the natural renewal of the air through windows and doors. If these two means are not sufficient, special arrangements must be made for ventilating the room.

Now, if the amount of heat passing through the walls is calculated, it will be found that this is comparatively small.

[1] Abstract of a paper read before the Manchester Local Section of the (British) Institution of Electrical Engineers.

For instance, I have assumed that a house of very ample size would be provided for the 6,000-kilowatt alternator mentioned before, and I have calculated how much heat would be conducted and radiated by walls, roof and floor. Assuming an outside temperature of 25° C. (= 77° F.) and a room temperature of 34° C. (= 93° F.) corresponding to conditions of a hot summer day in England, I find that this quantity of radiated heat only amounts to about 15 kilowatts, which is practically nothing compared with the total loss of 250 kilowatts.

Now, when it is admitted that special ventilation must be provided for the power house if large units are to be installed, it seems to me to be somewhat unreasonable, first, to let this quantity of heat enter the engine room (making it very uncomfortable to stay there), and afterward to adopt means to drive it out again and replace it continuously by air taken from outside. I rather think the idea must offer itself to the user that the best and easiest way would be not to let the hot air issuing from the machine enter the engine room at all, but to take it straight away from the machine to the outside through special ducts. A further consideration leads to the conclusion that it is also very advantageous for the cooling of the machine not to use the engine-room air as a cooling medium (as it is already warm to begin with), but to take the necessary cooling air direct from the outside atmosphere. This arrangement also enables the cooling air to be cleaned by passing it through a filter, thus avoiding dirt and moisture from getting into the machine.

But it is not only for the sake of convenience that, instead of ventilating the engine room, the machines should be ventilated directly. It is also very advisable to do this from the point of view of saving capital and running costs. This may best be explained by carrying out a comparative calculation of the amount of air required for cooling by the two different methods. If we provide a special ventilation scheme for the machine itself, we can, of course, allow the air to rise to a higher temperature, because it does not pass into the engine room. Calculations show clearly that by providing a ventilafion scheme as part of the machine plant instead of part of the building plant, a saving in capital outlay and running cost might be effected.

In conclusion, I should like to enumerate again the chief advantages of this system:

1. The machine is cooled with fresh, clean air, free from dirt and moisture, and therefore has a lower temperature rise than if the ventilating air was taken from inside the power house.

2. The machine is fully enclosed, and by this means the noise is reduced to a minimum.

3. The appearance of the machine is greatly improved.

4. The hot air issuing from the machine does not enter the engine room, so that it is quite easy to keep this at a moderate temperature.

5. The capital outlay for the necessary ventilating plant is smaller if the machines themselves are ventilated than if the engine room is specially ventilated.

6. In addition to this, it is quite possible to utilize the energy contained in the hot air. It could be used either for heating buildings, or heating feed water for boilers, or by blowing it into the boiler fires, or for all kinds of other useful purposes, so that one may regain part of the energy which would otherwise be lost entirely.

I am quite aware that there are at present different ideas as to whether or not such a ventilation scheme is to be recommended. But I am convinced that the final decision cannot be influenced by ideas, but only by facts.

The object of my statements is not so much to advocate one particular scheme of ventilation as the best. What I am aiming at is to impress upon people connected with the laying out of power stations for large high-speed units the great importance of not neglecting the ventilation problem. Careful calculations should always be made in this respect. The amount of heat produced is to be calculated, and then the architect of the building has to state how much heat will, under certain given conditions of outside and inside temperature, be radiated by the walls and the roof, and how much can be got rid of by the natural ventilation through windows and doors. The calculations will show that these two quantities represent only a very small percentage of the total amount of heat produced, and that therefore by far the greatest amount of that heat must be dealt with by special ventilating arrangements.

VOLTAGE REGULATION.

In order to build a machine which can give the greatest possible output at a minimum cost of manufacturing, we must get as much flux through the machine as possible, and provide the highest possible number of ampere-turns on the armature or stator, because at a certain given speed the output is proportional to these two quantities. Now, the number of ampere-turns determines the armature reaction, and in order to balance this under normal running conditions, and to keep the voltage regulation within reasonable limits, we have to provide a sufficiently high number of ampere-turns on the field, or, in other well-known terms, we must design the machine with a short-circuit current which is sufficiently high, compared with the normal current. With the ordinary slow-speed alternators, it has become quite a usual practice to design the machines such that with no-load excitation the short-circuit current is equal to about two and one-half to three times the normal current. This means that the number of excitation ampere-turns even for no load must be two and one-half to three times as great as the full-load ampere-turns on the armature. The amount of copper therefore to be provided on the field must be correspondingly greater than the copper in the stator.

In large multipolar alternators there is no difficulty in doing this, because there is plenty of space left between the poles for the field winding, on account of the very small angle formed by two adjacent poles. For our investigation we are only interested in the number of ampere-turns per centimetre pole-pitch. In order to arrive at an idea of the comparative amount of ampere-turns per centimetre pole-pitch, we have only to compare the useful winding space available in, say, a six-pole and a sixty-pole alternator. The ratio of the two available areas is, of course, not equal to the ratio of possible ampere-turns per centimetre pole-pitch, because the current density may be different in the two machines. Still, with due allowance for this difference, we can get an approximate idea of the actual conditions by simply comparing the useful winding space. Figures show that in the case of the six-pole turbo there is only about one-quarter of that winding space available which can be made use of in the sixty-pole slow-speed alternator.

It is therefore evident that we shall not find the slightest difficulty in the latter case to provide for a large number of ampere-turns and still keep the field quite cool. Or, in other words, we can easily design a slow-sped alternator with

a high short-circuit current, and consequently with a good voltage regulation, without being restricted by the heat limit of the field. The output of the generator will be more limited by the magnetic densities than by the armature strength (number of ampere-bars per centimetre circumference).

In the six-pole turbo it is clear that we must come up against the heat limit of the field, on account of the rather restricted winding space, and I think every designer of turbo-alternators will agree that the output of such a machine is never limited by the stator, but always by the rotor, whether this may be of the salient pole or of the cylindrical type.

In designing a machine which should be salable as regards price, one is bound to go to the heat limit of the rotor. But even then, for the simple geometrical reasons given, it will not be possible to obtain the same number of ampere-bars per centimetre as in a multipolar machine. Consequently the armature strength must also be reduced, which means a reduction in the output per centimetre circumference, with a corresponding increase in price per unit of output. Now, in order to prevent this increase in unit price from becoming prohibitive, we are driven to design the machine with a comparatively lower short-circuit current, because then we need not reduce the armature ampere-turns per centimetre in the same ratio as we are bound to do with the field ampere-turns. This, of course, results in sacrificing something of the regulation of the machine, and it is this point which I want to make quite clear to those who have to draft specifications for turbo-alternators. One should always bear in mind that it is not possible to obtain the same regulation figures with a turbo as with an ordinary multipolar slow-speed machine. When I say "it is not possible," I do not mean, of course, "physically impossible," but impossible from a "commercial" point of view, because the regulation of any given machine is only a question of rating, and therefore a low regulation can only be obtained by an increase of price per unit of output. However, it seems rather doubtful whether any station engineer or any corporation would be willing to pay a considerable excess of money in order to get a machine with the same voltage regulation as can without difficulty be obtained with a multipolar alternator.

Now, having outlined the reasons for the difference in the conditions of voltage regulation in the two classes of machines, I will go more into details and show some curves, which will give an idea of the quantitative difference in the two machines.

Fig. 3 represents a typical open-circuit characteristic which I have used as a basis for all further investigations. For the sake of comparison, I have chosen the scale so that I call the normal voltage 100 per cent, and also the corresponding no-load excitation 100 per cent. At this excitation the machine will have a certain definite value of short-circuit current I_k, while the normal current of the machine is I_n at a certain power-factor $= \cos \phi$, and we will measure the current, not in amperes, but simply by the ratio of its value to the short-circuit current, that is to say, $\frac{I_n}{I_k}$. This factor will therefore give the rating of the machine corresponding to its kilovolt-ampere output, on which the size of it will depend. For

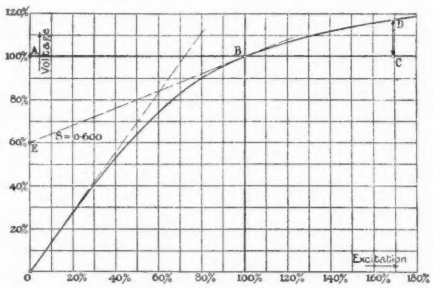


FIG. 3.—TYPICAL OPEN-CIRCUIT CHARACTERISTIC.

the station engineer, however, the kilowatt output of his machine is the more important quantity, and in order to introduce this into the comparative investigation we will call the watt component of the current I_w, which will, of course, be $= I_n \cos \phi$, and therefore the kilowatt output of the generator can be expressed by the ratio $\frac{I_w}{I_k}$.

If we now want to find the full-load excitation, we have to allow an increase in excitation due to three different factors: First, the increase in flux through the gap due to the armature leakage; secondly, the necessary ampere-turns to counterbalance the armature reaction; and thirdly, the increased pole leakage. Thus, we obtain a full-load excitation, represented by point C in Fig. 3. If the load is taken off at constant excitation and constant speed, the open-circuit voltage will then be given by point D, and therefore the distance CD represents the rise in voltage for inductive full load, and this is the quantity which the designer has to keep within a certain limit, in accordance with the specification he has to work to. The value of CD, however, does not solely depend on the distance BC, and therefore on the three factors mentioned above; but it is to a large extent also determined by a fourth factor, namely, by the shape of the open-circuit curve. It is evident that with the same excitation AC, a machine with a flat characteristic will have a smaller voltage rise than a machine with a steep open-circuit curve. As the shape of this curve depends on the saturation of the magnetic circuit, we must find a way to signify the degree of saturation prevailing in a machine. The simplest way to do this is to introduce the slope of the curve at the point of normal voltage. For this purpose we will draw a tangent to the curve at the point B, which will cut the ordinate axis at a point E. It is clear that this point E will be higher the greater the saturation is. We will therefore call the factor $S = \frac{OE}{OA}$ the "saturation factor" of the machine. In the case of Fig. 6 we find $S = 0.600$.

We now can say that the voltage rise depends on the following four factors:

1. Armature leakage.
2. Armature reaction.

} Proportional to load current.

3. Increase of pole leakage.

} Partly influenced by saturation factor.

4. Saturation factor.

If a special machine is designed to meet a certain specification, then the designer can choose to a certain extent the value of factor No. 3, by so fixing the dimensions of the magnetic path that he obtains the most suitable initial pole leakage at no load to meet the conditions of specification. In most cases, however, the designer will, from a manufacturing point of view, avoid special designs, and will want to put forward standard machines. In such cases he is more or less tied down to a certain initial pole leakage, and if he has to fulfill certain conditions of voltage regulation, he can only do this by choosing suitable values for the quantities given under Nos. 1, 2 and 4.

This is the reason why I have restricted myself in the following to an investigation of the influence on voltage rise, of the rated load current, and the saturation factor. The two variable quantities for

this investigation will therefore be the ratio $\frac{I_n}{I_k}$ or $\frac{I_w}{I_k}$, and the factor S. The calculations have been carried out for various power-factors, namely, cos $\phi = 1$, 0.95, 0.90, 0.80, 0.70 and zero, and have in most cases been extended over a range of $\frac{I_n}{I_k} = 0$ to $\frac{I_n}{I_k} = 1$, and a large number of curves have been plotted for the different conditions.

These curves show clearly that it is advisable to work at relatively high saturation, especially in the case of machines which are to be designed for a relatively low short-circuit current, that is to say, for a high ratio of $\frac{I_w}{I_k}$, whereas in machines with a high short-circuit current the saturation factor has not so great an influence on the regulation. However, as the high increase of exciting current at high saturation is not desirable, one is obliged to work at lower saturations than one would do if only the voltage regulation had to be looked out for. We must therefore make a compromise, and from my experience I find that for a modern machine the saturation factor should be between 0.50 and 0.60. The values of rise corresponding to these two values of saturation factor have been plotted against the power-factor in Fig. 4.

We find that for geometrical and physical reasons one is bound to work a turbo at a higher value of $\frac{I_w}{I_k}$ than is possible with a multipolar. As fair average figures we can assume $\frac{I_w}{I_k} = 0.50$ for a turbo, and $\frac{I_w}{I_k} = 0.30$ for a slow-speed machine. The two pairs of curves given in Fig. 4 can therefore be taken as representing relative conditions in the two classes of machines.

From what I have said before it is evident that the price will be affected by the specified figure for voltage regulation. A machine with small regulation is bound to be more expensive than one with a larger regulation figure. In order to make a comparison, I have not worked out a new design for every different condition, but have simply modified the rating of a standard size, so as to fulfill various conditions of regulation, the price remaining constant for that machine.

Let us assume that a standard three-phase machine gives 1,000 kilowatts at cos $\phi = 0.80$, 100 amperes normal current, $I_w = 80$ amperes watt current (or current at unity power-factor), the no-load excitation will be 100 amperes, $\frac{I_w}{I_k} = 0.50$, that is to say, the short-circuit current will be $I_k = 160$ amperes. The full-load excitation (in accordance with curves) will be 169 amperes, the saturation coefficient of the open-circuit curve S = 0.60. The rise in voltage will then be 17 per cent for cos $\phi = 0.80$, while the corresponding figure for unity power-factor will be 6.2 per cent. For the sake of argument we will assume that the price for this machine will be £1 per kilowatt.

Now we will take the case of a specification which calls for rather a low voltage-regulation figure, as can be obtained without great difficulty on slow-speed alternators. We will take, for instance, 14 per cent for cos $\phi = 0.80$, and 4.5 per cent for unity power-factor. As it would not be advisable to work the machine at a higher flux density in order to flatten the open-circuit curve, the only means left for obtaining the lower regulation figures

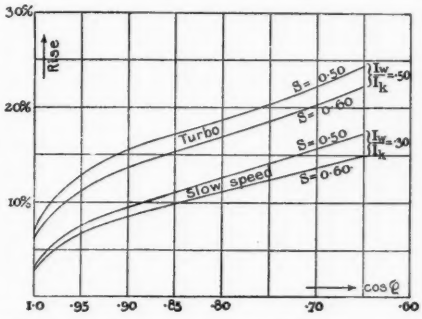


FIG. 4.—RELATIVE CHARACTERISTICS OF HIGH AND LOW-SPEED MACHINES.

would be to work it with a lower ratio of $\frac{I_w}{I_k}$, or, in other words, with a higher ratio of short-circuit current to normal current. Now, again, it is not possible simply to increase the excitation ampere-turns by increasing the gap, as the rotor field winding is already designed to the thermal limit. So, if no higher temperature rise is permissible, the desired result can only be obtained by a reduction in the rating of the machine. We will now find out how much that will be.

From curves we find that a ratio of $\frac{I_w}{I_k} = 0.40$ will give the figures specified. The rated current would therefore have to be reduced in the ratio $\frac{0.40}{0.50} = 0.80$. However, we can now make a correction, because for this lower output the exciting current will also be lower—namely, only 153 amperes, while our machine is designed to stand 169 amperes excitation. We can therefore increase the excitation ampere-turns in the ratio of $\frac{169}{153} = 1.104$ either by increasing the air-gap or by working the machine at a slightly higher density. This, however, enables us to put up our rated current to such a value that it still fulfills the relation $\frac{I_w}{I_k} = 0.40$. As I_k is proportional to the no-load excitation, it follows that we can increase I_w proportionally to the permissible increase in excitation. We therefore find that the rating of our machine is to be $0.80 \times 1.104 = 0.884$ of the standard rating. The price per kilowatt would therefore now be $\frac{1}{0.880} = £1.132$ per kilowatt.

A small reduction is perhaps possible, because the stator copper can be reduced by 11.6 per cent, corresponding to the reduction of normal current output. So we can say the reduction in voltage rise from 6.2 per cent to 4.5 per cent at unity power-factor, and from 17 per cent to 14 per cent at cos $\phi = 0.80$ is to be paid for by an increase in cost of 13 per cent.

It must, however, be kept in mind that this figure only holds good in case the modified output of the machine happens to coincide with the output called for in the specification. In reality specifications are accustomed to call for outputs in round figures, and the manufacturers also design their standard machines to give an output in round figures. If, therefore, a voltage regulation is specified which falls outside the figures of a properly designed standard line, it will, in most cases, be necessary to put in the next larger size of machine, so that the price per kilowatt will still be increased.

POWER-FACTOR.

I will now deal with the rated power-factor and its influence on the rating and the price of the machine.

It seems to suggest itself to the buyer of an alternator that he will be on the safe side if he orders the machine for a lower power-factor than is actually prevailing in his power station. As a matter of fact, this is very often done in practice. We will now see what he is to gain by this method.

We take again, for the sake of comparison, the same standard machine as before, with a price of £1 per kilowatt. Now, we will assume that, for the sake of getting a "bigger machine," the power-factor be specified as 0.70, while the actual power-factor in the station be 0.80. For

1,000 kilowatts the current at $\cos\phi = 0.70$ would then be $I_n = \frac{80}{0.70} = 114.2$, and $\frac{I_n}{I_k} = \frac{114.2}{160} = 0.715$. The curve for $\cos\phi = 0.70$ shows that for this load an exciting current of 192 amperes would be required, while the permissible current for the standard machine is only 169 amperes. This would mean about 35 per cent more heat in the field, with a correspondingly higher rise, which, of course, is not permissible. We have, therefore, to reduce the current output of our machine to such a value that at a power-factor of 0.70 the full-load excitation is equal to the normal figure of 169 amperes. From the same curve we find this armature current to be $= 0.556\ I_k = 90.5$ amperes; this gives a watt current $I_w = 0.70 \times 90.5 = 63.4$ amperes against 80 amperes of the standard machine. In other words, the output of the standard machine is reduced to $\frac{63.4}{80} \times 100 = 79.2$ per cent, or 792 kilowatts, and therefore the unit price increased by 26.5 per cent. This, of course, refers to the output stated on the nameplate to specification. The fact, however, that the actual power-factor is 0.80 instead of 0.70, as specified, will enable the station engineer to take more output out of the machine than is stated on the nameplate. The latter gives him as normal stator current the figure 90.5 amperes. With this current at his actual power-factor of 0.80 he can get a watt current of $0.80 \times 90.5 = 72.5$ amperes against 63.4 amperes, at $\cos\phi = 0.70$. He will therefore be very happy that, by specifying a lower power-factor, he gets an increase of output of 14.2 per cent "for nothing," or that the price per kilowatt which he actually gets out of his machine is only 87.5 per cent of the "nominal" price per kilowatt "rated" output. However, if he were aware of the fact, explained before, that the price per "rated" kilowatt of this machine is 26.5 per cent higher than it would be if designed for the correct power-factor, he would come to the conclusion that his unit price is actually $1.265 \times 0.875 = £1.107$ per kilowatt, while it would have been £1.00 per kilowatt if the machine had been built to suit the actual requirements.

In other words, he does not get 14.2 per cent more output "for nothing," but he pays 10.7 per cent more money "for nothing." Or probably still more, because it will, in most cases, happen that on account of the low power-factor the next larger standard will be put forward.

In order to make these facts still more evident, we can make the following comparison: The standard machine would be designed for 100-ampere stator current and 169-ampere rotor current, both windings being so dimensioned as to give the permissible temperature rise. The machine, which is actually put forward "to meet the requirements of the specification," will be designed for 90.5-ampere stator current, and 169-ampere rotor current—that is to say, with less stator copper, these two currents referring to $\cos\phi = 0.70$. The machine, however, will be run under actual load conditions with its rated stator current of 90.5 amperes (but with increased kilowatt output corresponding to $\cos\phi = 0.80$). From the curve for $\cos\phi = 0.80$ it is found that the necessary exciting current for $\frac{I_n}{I_k} = \frac{90.5}{160} = 0.566$ will be 161 amperes, or eight amperes less than the permissible current of 169 amperes. From this it is evident that although the engineer takes 14.2 per cent more output out of the machine above its rated capacity, he does not get the full benefit out of the capacity of the rotor, and if he would try to do this he would exceed the thermal limit of the stator.

It is therefore only to the interest of the customer to specify the actual conditions of power-factor under which the machine is to work, and not to include a margin where it is only detrimental to himself to do so.

SUMMARY.

The following are the conclusions to be drawn from my investigations:

1. If large turbo units are to be installed the problem of ventilation is not to be neglected, as one has to deal with large quantities of energy produced in a relatively small space. The best scheme seems to be to provide ducts for getting fresh air from outside the building to cool the machine and for taking the hot air away without allowing it to enter the engine room.

2. When specifying the voltage rise of a turbo-alternator due allowance should be made for the fact that the figures obtainable are not so low as those which can easily be obtained with multipolar machines. As fair figures for turbo-alternators can be regarded—

5 to 7 per cent for unity power-factor;
13 to 15.5 per cent for $\cos\phi = 0.90$; and
15 to 18 per cent for $\cos\phi = 0.80$.

3. When specifying the power-factor at which a turbo-alternator has to work, it is of no use to put in a lower figure than is actually prevailing in the station, as nothing can be gained by this, and it would, if anything, decrease the possible output of the machine.

Receivers Appointed for the Rockingham Power Company.

Receivers were appointed on November 23, by Judge J. C. Pritchard, of the United States Court, at Rockingham, N. C., for the Rockingham Power Company. William H. Browne and W. A. Leland were named.

The application for the appointment of receivers was made by the S. Morgan Smith Company, of York, Pa., manufacturer of hydraulic apparatus and waterwheels, who had the contract to supply and install the waterwheels and adjunct parts for the plant. The petition was made by this company, both as contract creditor and as a large owner of the bonds and stock of the Rockingham Power Company. The bill of complaint alleges that dissension among the members of the board of directors, and the action of the firm of Hugh McRae & Company, of Wilmington, N. C., who had undertaken to seize certain property essential to the development of the plant, and of which the company is said to be the equitable owner, and out of which seizure conflicts have taken place, impaired the credit and militated against the efforts of the majority of the holders of the bonds and of the board of directors and management in the procurement of additional funds required for the completion of the plant.

Mr. Leland has been in charge of the construction work, and Mr. Browne has been general manager of the company.

At the beginning of the year the bondholders of the Rockingham Power Company appointed from among their members a reorganization committee, which formulated a plan of procuring the additional money needed for the completion of the plant.

Under the order of the court, the receivers are continuing the work of construction, carrying it on in the same manner as it had been proceeding prior to their appointment.

New Independent Telephone Company.

The Valley Home Telephone Company, a corporation which is to take over practically all the so-called independent telephone interests in northeastern Michigan, including the exchanges at Saginaw, Bay City and Flint, has been organized. The authorized capital of the new company is $2,500,000, divided into 25,000 shares.

Chicago Traction Consolidation Under Consideration.

From time to time during the past year tentative negotiations have been made looking to the consolidation of the four elevated railway companies in Chicago. These have never met with success, owing to inability to agree on the financial readjustments that would be required. During the past week or so such negotiations have been resumed on what was said to be a larger and more promising scale. It was proposed now to merge not only the elevated railways but the surface lines as well into a huge unified corporation controlling practically all the traction facilities of Chicago and its suburbs. There would seem to be greater difficulty in harmonizing so many interests in view of the previous partial attempts. However, the task has been asserted to be less formidable because of a number of features that are aiding the consolidation idea. These are a general sentiment in its favor on the part of the municipal authorities and the public as a whole.

The present negotiations, unlike many of the previous ones, are being pushed by local financiers and capitalists that are directly concerned in the several properties. A number of conferences have been held under the direction of John J. Mitchell, president of the Illinois Trust and Savings Bank, and Samuel Insull, president of the Commonwealth Edison Company. At one of the meetings these two gentlemen with Chauncey Keep, John A. Spoor, Henry A. Blair, W. U. Eisendrath and Wallace Heckman were appointed a committee to consider the subject in all its aspects. These gentlemen represent the New York financiers as well as the Chicago interests, and practically assure the careful consideration of any consolidation project on the part of all financially concerned. If the merger is carried out to take in all the traction interests of the city, i. e., the four elevated and two surface companies, the total capital in stocks and bonds that will be involved will be close to $200,000,000.

Later accounts, however, seem to indicate that the present move will be confined to the Chicago City Railway Company and the Chicago Railways Company, which control practically all the surface lines in the city and have a combined capitalization of about $100,000,000. These two companies are now operating under the similar traction ordinances passed by the City Council in February, 1907, and approved by popular vote in April of that year. Under the supervision of the Board of Supervising Engineers, Chicago Traction, they are rehabilitating their systems on a plan contemplating ultimate unified control.

The Commonwealth Edison Company has been mentioned in the present negotiations as being one of the parties to the enlarged consolidation scheme. This statement is denied by the officials of the company. Its interest in the plan is indirect and arises from the fact that it is under contract to supply all the electric power for the Chicago City Railway and the Chicago & Oak Park Elevated Railroad as well as a large percentage of the power required by the Chicago Railways Company and the Metropolitan and Northwestern Elevated railways.

Harlem River Line to Be Electrified.

Application has been made by the New York, New Haven & Hartford Railroad Company and the Harlem River & Port Chester Railroad Company to the New York State Public Service Commission for permission to change the motive power of the latter road from steam to a high-potential alternating electric system similar to the system in use on the New Haven's main line between New York city and Stamford. It is believed that the intention is to make the smaller line the main line eventually and to establish connections through it with the New York Connecting Railroad in Queens and with the proposed Lexington Avenue subway which President Mellen of the New Haven has said his company may offer to build.

The petition sets forth that the New Haven is the lessee of the Harlem River & Port Chester Railroad, and that as it is now operating its main line by electricity, it desires to extend the same system to the operation of the leased lines.

The company states that it intends to finance the project from the proceeds of an issue of $15,000,000 of bonds known as the New York, New Haven & Hartford-Harlem River & Port Chester first mortgage four-per-cent fifty-year gold bonds. This issue was secured by a first mortgage dated May 16, 1904, made to the United States Trust Company as trustee. The issue was consented to by the then Board of Railroad Commissioners on September 6, 1904.

Should the applicaton be granted and the improvement installed the New Haven will have an outlet for its passenger traffic over the Connecting Railroad, and thence through the Pennsylvania's East River tunnels to Manhattan. If eventually the company should build and operate the Lexington Avenue tunnel, as Mr. Mellen once stated he hoped would be the case, the local passenger traffic will doubtless be diverted from the main line at the Mott Haven yards and sent into Manhattan through the new subway.

Successful Starting Up of the 6,000-Horsepower Motor at Gary, Ind.

The 6,000-horsepower, three-phase, twenty-five-cycle induction motor installed in the rolling mill of the Indiana Steel Company at Gary, Ind., by the General Electric Company, was started for the first time on Sunday, November 29. This is the largest individual motor unit in the world, and was assembled and erected on its own foundation ready for actual service before any tests of the machine were possible.

Two 2,000-kilowatt Curtis turbines were put in operation to supply the current for the motor, but at first the question of applying the 6,600 volts direct gave the engineers some concern. It was confidently determined, however, by the erecting engineers that the General Electric system of step-by-step control, using a master controller, would take care of the high voltage. This master controller gradually inserts resistance in a number of steps, starting at 1,350 volts, to full voltage.

To the satisfaction of everyone present, the motor started in the right direction—counter clockwise—and attained full speed in forty-five seconds. The starting or magnetizing current at the first jump was indeterminable, and for the following thirty seconds stood at 540 amperes, gradually dropping down to eighty-five amperes. Owing to outside conditions—the turbines feeding South Chicago at the same time—the voltage was about 5,600 during the first part of the test.

The operators in charge of the turbines reported a very satisfactory operation of these prime movers, and the meter readings were satisfactory at the meter board.

One can imagine the size of this equipment when it is known that it requires 300 gallons of lubricating oil in each of the bearings.

Telephone Injunction.

United States Judge Tayler, at Cleveland, Ohio, has issued an injunction restraining the American Telephone and Telegraph Company and the Central Union Telephone Company, both of them allied with the Bell system, from alleged interference with the business of the independent companies operating in Ohio, Indiana, Illinois and adjoining states.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

THE INFLUENCE OF ROENTGEN RAYS ON THE STARTING OF THE BRUSH DISCHARGE.

A paper on this subject was read by E. Marx at the annual meeting of the Association of German Physicists and Physicians. In order to measure the velocity of the Roentgen-rays, the author made use of their property of facilitating the starting of the brush discharge when they strike the negative pole of a spark gap. As there existed no record of an experimental investigation of this pole-releasing effect of the Roentgen-rays, the author examined their influence on a spark gap in a direct-current circuit, consisting of a platinum electrode and an aluminum window. This arrangement was chosen for the reason that it had previously served for determining the velocity of the rays. The aluminum window was grounded, and the platinum electrode, upon which the Roentgen-rays impinged, was alternately used as anode and cathode. It was demonstrated that in the first case the discharge was not only facilitated by forty per cent, but that—and this was so far unknown—in the second case the discharge took place with considerably greater difficulty than when no Roentgen-rays fell on the spark gap.—*Translated and abstracted from Physikalische Zeitschrift (Leipsic), November 1.*

WIRELESS TELEPHONY.

In the course of a description of wireless telephone systems, with which notable results have lately been achieved, it is stated that the Danish engineer, Valdemar Poulsen, has established perfect wireless telephone communication at a distance of 270 kilometres between two stations in Denmark. The primary energy was 900 watts, the radiated energy 300 watts; the masts were about sixty metres high and the wave-length was 1,100 to 1,200 metres. Communication was also established between Linkby and a station near Berlin, a distance of 500 kilometres. The German Gesellschaft für Drahtlose Telegraphie has developed the Telefunken system and has established satisfactory communication between Rheinsberg and Berlin, a distance of seventy-five kilometres. The masts used were twenty-six metres high, the primary energy 440 volts and five amperes. De Forest has reached distances of twenty-five miles by means of the arrangement devised by him.—*Translated and abstracted from Elektrotechnischer Anzeiger (Berlin), October 29.*

EFFECT OF ELECTRIC STREET RAILWAYS ON MAGNETIC OBSERVATORIES.

The opening of an extension of the Potsdam electric street railway had to be delayed on account of objections raised by the Magnetic Observatory there until the cause of disturbances noted had been removed. The authorities had originally made the condition that the magnetic disturbances caused by the operation of the railway should not exceed 0.00001 centimetre-gramme-second at the Observatory. The old railway fulfilled this requirement by adopting a method devised by its manager of feeding and insulating the rails, so completely, that the allowed limit of disturbance was approached only within fifty per cent. Similar conditions were made for the new extension from Potsdam to Nowawes, which approaches the observatory within 1.1 kilometre. The same method of feeding and insulating the rails was adopted, and during the final test the installation did not cause greater disturbances than were expected from calculations, amounting to 0.000003 centimetre-gramme-second. But during a preliminary trial an erroneous connection was made and two separate rail nets were charged with current under a difference of potential of sixteen volts, which gave rise to earth currents and distant magnetic effects of about tenfold strength. Against this disturbance resulting from the preliminary test the authorities raised objections.—*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin), November 5.*

EXPLOSION GAS TURBINE OR COMBUSTION GAS TURBINE.

The present installment is a continuation of an article previously noted in these columns, the explosion turbine being dealt with. Such a machine might be constructed by sending explosive mixtures of gas and air into a series of explosion chambers by means of a compressor in such a way that one chamber will explode after the other in regular succession, and leading the exploded gases into a turbine. An arrangement of this kind with ten explosion chambers has actually been constructed, but the combination of so many different turbine elements intended to work in common is a source of great loss. Besides this, the apparently simple problem of supplying the explosion chambers with gas by means of special compressors, which are in turn dependent on the turbine, is difficult to carry out in practice and causes unreliability of operation. Drawings are shown of an arrangement which appears to the author more practicable. The compressor, explosion chamber and partly, also, the turbine, form one and the same part of the gas turbine and successively perform the various functions. Calculations of the theoretical efficiency of this arrangement are given in detail. The conclusion arrived at is that the thermo-dynamic prospects of the explosion gas turbine are not brilliant; however, an absolute thermal efficiency of fifteen to twenty per cent can be attained, and competition with the steam turbine will therefore be possible. A factor in favor of the gas turbine is its simplicity, due to the absence of the steam boiler. The explosion turbine seems to be the only possible solution of a gas turbine, and its success will depend in a large measure on its perfect construction, which can be developed only by practical experience.—*Translated and abstracted from Die Turbine (Berlin), October 20 and November 5.*

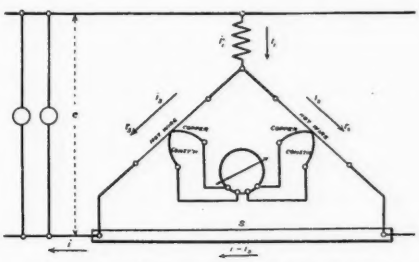
THE STERILIZATION OF WATER BY OZONE.

The Siemens & Halske Company has been manufacturing for some time three standard sizes of sterilizers—a laboratory apparatus, an apparatus for small communities or factories, and a portable apparatus for army purposes. In each type the essential elements comprising the sterilizer are an ozonizer, an electrically-driven compressor with the necessary accessories, a high-tension transformer, a sterilizing column, and a measuring arrangement. The construction of the ozonizer differs in the various models, but in principle it consists of discharge tubes, each element

being composed of two concentric tubes, the outer one of glass being immersed in cooling water; the inner one is of aluminum or glass, and in the latter case it is filled with water for conducting the current. The compressor draws the air through drying tubes, blows it through the ozonizer, where it is electrified, and then into the sterilizing tower. This is a simple scrubber, a column of glass or sheet metal filled with glass balls or pebbles, through which the water percolates from the top and is brought in contact with the purifying gas during its passage. The measuring arrangement consists of a glass vial with a mercury seal filled with a solution of iodide of potassium, a gas meter for measuring the ozonized air, and an aspirating vial, which, when once graduated, may take the place of the gas meter. This vial is not necessary when the pressure is sufficient to drive the gas through the solution. The laboratory model can be attached to incandescent-lamp sockets. It is capable of treating 500 to 1,000 litres of dry atmospheric air an hour (ozone contents five to six grammes) and consumes one-fourth to one-half horsepower; if oxygen is used, the ozone is doubled or tripled. The portable outfit intended for army use has been adopted by some governments, especially Russia. It is carried on two wagons, weighing about 900 kilogrammes each, and is guaranteed to sterilize from two to three thousand litres of water an hour, utilizing, under ordinary conditions, not more than one-half or one-third of the ozone produced. The output of the ozonizers is illustrated by curves, which show that the production of ozone per horsepower-hour increases with the velocity of the flow of air through the ozonizer. However, the concentration of the ozone—that is, the number of grammes per cubic metre of air treated—diminishes under the same conditions. This is explained by the fact that, when the air circulation is slow, the ozonizing effect is immediately followed by decomposition. In practice, it is impossible to go below certain limits with the concentration.—*Translated and abstracted from L'Electricien (Paris), November 7.*

THERMO-WATTMETERS.

For the purpose of measuring high-frequency currents, R. Van Cauwenberghe has devised an arrangement consisting of two Voege thermo-elements and a differential galvanometer, thus constituting what he terms a thermo-wattmeter. The principal quality of the arrangement is that it possesses no appreciable self-induction or capacity and offers no skin-effect, even with frequencies as high as 10,000 periods per second. The thermo-element of Dr. Voege consists of a straight hot wire soldered in the middle to the place where the elements, copper and constantan, unite, the entire element being enclosed in a rarefied atmosphere. This thermo-element is much more sensitive than that with a spiral, but requires the use of a differential galvanometer in order to prevent the current intended for the galvanometer from being partially shunted



CONNECTIONS FOR THERMO-WATTMETERS.

by the hot wires connected in series. Galvanometers with permanent magnets and two-wire movable coils are recommended. The author expresses the fear, however, that long use may cause a modification of the elements and be detrimental to the accuracy of the measurements. The circuit arrangement is shown in the accompanying diagram.—*Translated and abstracted from La Lumiere Electrique (Paris), October 31.*

AN ELECTRICALLY-DRIVEN ROLLING MILL.

The electrical equipment of Dorman, Long & Company's wire mills, at Middlesbrough, in the northeastern district of England, has recently been completed by the Electrical Company, Limited. The operation of the reversing rolling mill is on the Ilgner system, in connection with Ward Leonard control. The Ilgner set consists of a flywheel, motor-generator, the generator of the direct-current type, coupled in series with the mill motor. The generator field is controlled by an exciter, and the variation or reversal of the small exciting current provides for the entire control of the rolling-mill motor. The stored-up energy in the flywheel is made to neutralize the otherwise heavy current demands at periods of peak load on the mill, this being achieved by compulsorily decreasing the speed of the Ilgner set during such periods by means of a liquid resistance automatically governed by a regulating motor, which introduces resistance into the rotor circuit of the driving motor as required. The torque exercised by the regulating motor varies with the main current. An increase of the latter to maximum value enables the regulating motor to lift the electrodes, and thus introduce the necessary resistance; while, on the other hand, a decrease in the main current to a predetermined value, such as occurs when the mill runs empty at the end of a pass, decreases the motor torque, allowing the electrodes to fall, and ultimately short-circuit the rotor of the driving motor of the Ilgner set, which consequently speeds up, enabling the flywheel to store energy for the next peak load on the mill. The plant at the Dorman works operates a rolling mill containing two housings with sixteen-inch-diameter rolls, intended for rolling angles and small girders. The mill is coupled to a compound-wound, 600-volt motor of 1,200 horsepower capacity, with a maximum output of 3,600 horsepower, and a varying speed of from zero to 110 and 160 revolutions per minute. The maximum torque of the motor is 232,000 foot-pounds. The Ilgner set consists of a 950-horsepower motor, operating on three-phase current at 2,750 volts pressure, forty cycles, coupled direct to a 1,250-3,600-horsepower dynamo, giving 600 volts, and attached by a coupling to two twenty-ton flywheels mounted on a separate shaft. If the maximum demand of the rolling-mill motor on certain work does not exceed 950 horsepower, it is possible to disconnect the flywheels. The Ilgner generator is provided with compensating coils on the Deri system for the purpose of reducing the armatutre reaction, securing sparkless commutation at all loads, with a fixed brush position. To start the Ilgner set, a special barring gear is provided, consisting of a fifteen-horsepower motor, with the necessary gear, this being cut off automatically when the set reaches a speed of three revolutions per minute. The flywheels, which are each fourteen feet in diameter, are equipped with powerful water-cooled brakes for quick stopping. The exciting set consists of one three-phase motor of eighty horsepower capacity, running at 2,750 volts, forty cycles, coupled direct to two continuous-current dynamos, one of which serves to excite the fields of the Ilgner generator and the mill motor, and the other excites a special compound winding on the mill motor. This is with the object of strengthening the field, and thus decreasing the speed at sudden heavy overloads.—*Abstracted from the Electrical Review (London), November 13.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

The Ridgway Side-Crank Engine.

Well-informed engineers recognize that for some purposes the side-crank type of engine construction is most satisfactory, although to produce a machine of this type certain valuable features of the center-crank engine must be sacrificed. Constructed with a view toward the high quality which characterizes its well-known center-crank line, the Ridgway Dynamo and Engine Company, Ridgway, Pa., has brought out the Ridgway side-crank engine. Like the older line, this engine has been designed for simplicity, strength and quality.

In the construction of these engines the best materials are used by skilled workmen, and all parts are made to standard gauge and are interchangeable wherever possible. After passing numerous inspections the completed engine is erected on the testing floor, connected to a dynamo loaded with a water rheostat, and subjected to a test lasting from ten to twenty-four hours, under full and overload conditions.

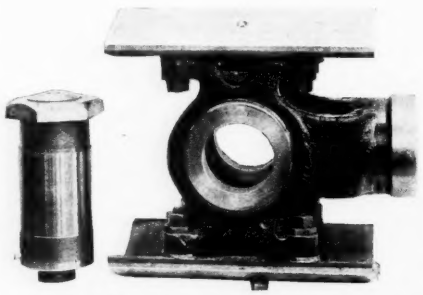
The engine bed is of heavy design throughout, with the metal so distributed as to bring the heaviest sections in line with the greatest strains. Careful consideration for small details, as well as for pleasing outlines, has been observed. The main part of the bed is of a box section having bored guides of large diameter. The guides and end for the cylinder are bored and turned at one setting, insuring the perfect alignment of bed and cylinder.

At the cylinder end of the bed is a removable partition which prevents oil from being thrown against the end of the cylinder. Between the cylinder and the partition is a well in which the drip from the stuffing-box is caught. The water is removed by an efficient separator, and the oil flows back to the crank pit. The crank disc is covered with an oil-tight guard of light sheet steel, hinged at the top so that it may be turned back over the bed, giving access to the connecting rod and crank-pin.

The main bearing on all sizes is of the quarter-box type. The shells are lined with babbitt metal peened in place and bored out in accurate jigs, and are, therefore, interchangeable in engines of the same size. Horizontal adjustment is secured by a wedge, and vertical adjustment by drawing down the cap.

The connecting rod is forged from open-hearth steel and is designed with a minimum factor of safety of fifteen. The straps at both ends are slotted out of the solid forging. The wrist-pin box is of phosphor-bronze, while the crank-pin box is lined with babbitt peened and bored. Both ends are adjusted by the wedge and bolt method.

The cross-head body is of cast-steel of a substantial design. The lower shoe is adjustable, and, besides bolts, means have been provided for adjusting both top and bottom shoes by the use of shims, if desired. The wrist-pin is provided with keys so that it may be turned ninety degrees as it wears.



CROSS-HEAD AND PIN, RIDGWAY SIDE-CRANK ENGINE.

The cylinder and valve on this engine are of the same design which the manufacturer has used for over fifteen years on the center-crank engines. The cylinder is cast of a hard, close-grained iron, and the barrel is covered by heavy polished cast-iron lagging. The valve is of the flat balanced type and moves between the seat and a heavy pressure plate. Cored ports in the pressure plate corresponding to those in the valve seat and connecting through side openings with the main ports, make this a double-ported valve. This construction gives an indicator card in which the steam line holds up well and cut-off is very sharp. In case of water being carried into the cylinder, the holding spring allows both valve and pressure plate to lift from the seat, permitting the water to pass into the exhaust. Relief valves are, therefore, not necessary.

The piston is a single hollow casting, strongly braced by ribs and made as light as is consistent with strength. The rod and piston are joined by a force-taper fit, supplemented by a jamb nut held by a set screw.

The main shaft is a single forging of the best open-hearth steel. It is extra large in the bearings and proportionately increased in the governor wheel hub. The crank disc is made of a mixture of cast-iron and steel designated as semi-steel, the result being a tough, close-grained, hard iron. The crank-pin is cast solid with the disc. The shape of the disc forms the counterbalance, a feature not secured on side-crank engines by using a circular disc. The fitted crank is forged to place on the shaft under hydraulic pressure and is secured by a heavy key.

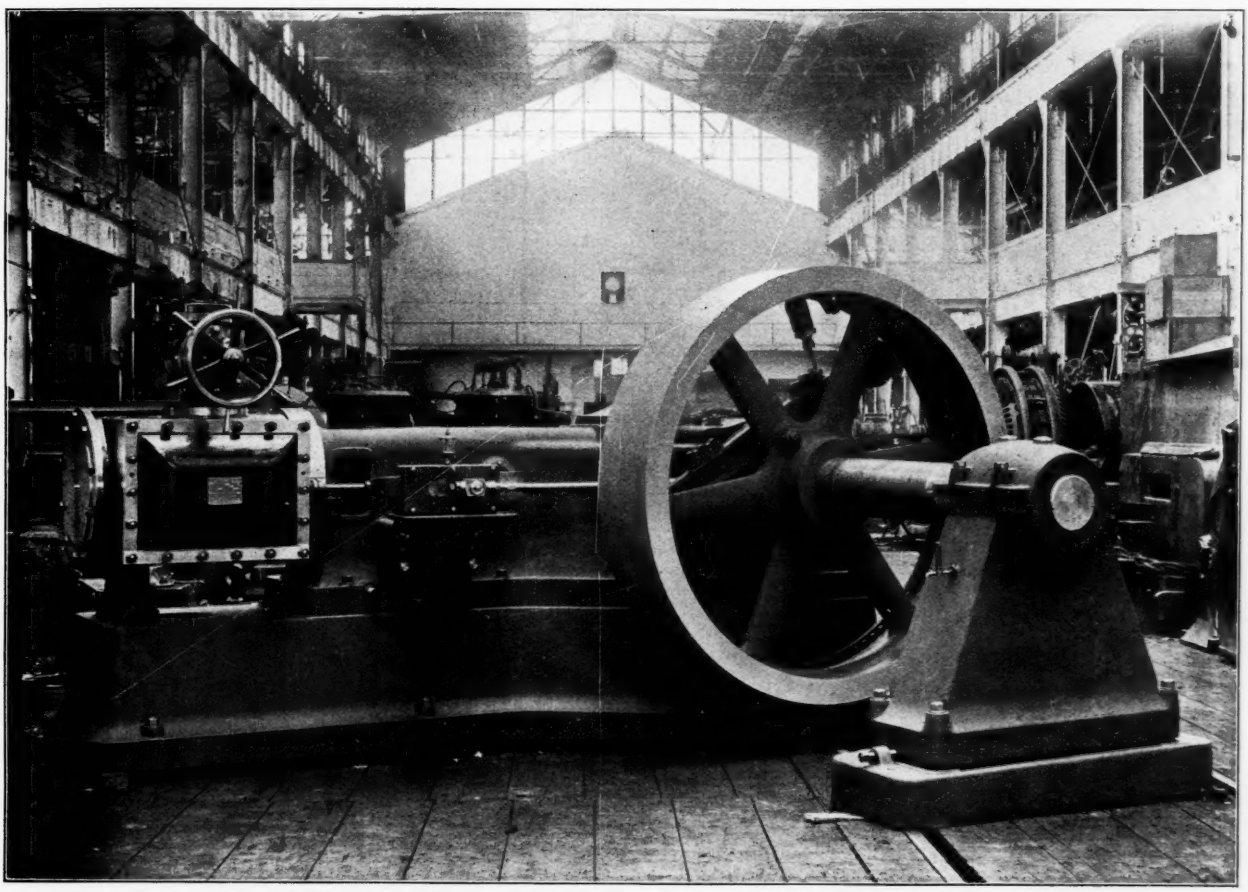
The Ridgway governor, formerly known as the "Begtrup," was the pioneer inertia governor, and is described as follows: A long bar, called the inertia bar, having weights at each end, is pivoted at the center on a roller bearing. The inertia bar is lined with hardened steel bushings and the space between the main pin is filled with hardened steel rollers. This insures a minimum of friction and a bearing subject to very little wear. This is the only bearing requiring lubrication, although it will go without attention for several weeks. To the hub of this bearing is clamped the eccentric, which being split, is removable without disturbing the governor or the setting of the valve. A heavy coil spring is secured to the middle of one end of the bar. Opposite the spring is an oil dashpot, having its connecting rod bolted to the inertia bar. A by-pass with an adjustable opening allows the oil to circulate from one side of the piston to the other. The governor is reversible without the use of any extra parts.

The action of the governor is as follows: Rotating from right to left, the weight in the spring end of the bar being the greater, centrifugal force tends to swing it outward and backward toward the lower stop. This tendency to move backward is balanced by the spring, whose tension is such as to hold the inertia bar in equilibrium when the engine is at its de-

sired speed. When starting up the eccentric travels in its greatest path, giving the valve its widest opening and latest cut-off. As the speed increases, centrifugal force acting on the weighted end of the inertia bar moves it backward to the lower stop, reducing the travel of the valve and cutting off steam earlier. This backward movement of the bar is continued until the travel of the valve reduces cut-off to the amount necessary to keep the engine rotating at its proper speed to give an even balance between centrifugal force acting on the inertia bar and the opposing tension of the spring. If a load is now applied to the engine, there is a check to the speed of the governor wheel, while the inertia bar, by reason of its momentum, rotates forward sufficiently to increase valve travel and give late enough cut-off to carry the load. Should the load be thrown off, this wheel tends to increase its speed, causing the inertia bar to swing backward and reduce valve travel and cut-off until equilibrium is re-established.

In harmony with the proportions of the bed and sub-base, the outboard bearing pedestal is built on liberal lines and made broad at the base to insure stiffness. The bearing is of the self-oiling, self-aligning type; the shells being lined with babbitt peened and bored. Vertical adjustment is accomplished by means of special devices used on the cross-head and applied to the four bolts at the base of the pedestal.

Two standard methods of lubricating the engine are provided. In the first, known as the "splash" system, the crank pit is filled with oil, which the disc throws in an almost steady stream over the cross-head and guides. Oil from the upper guide is wiped off by the top cross-head shoe and flows through passages and pipes to the cross-head pin. Pockets on the inside of the crank guard collect great quantities of oil which are led through ample passages to the main bearings and to the crank-pin. All bearings are, therefore, practically flooded at all times. This is the usual lubrication system furnished by the manufacturers. The other system uses a small but efficient filter placed in one side of a tank, which is mounted on the sub-base below the slide bracket. In the other side of the tank is a valveless pump driven by a cam on the valve-gear ram. This cam is designed to give a full stroke regardless of the travel of the ram. All oil from the bearings flows to the crank pit, from which it is piped to the filter, then passes to the pump chamber, where it is pumped to a large tank on top of the bed. From this tank the oil flows through nickeled piping to each bearing. Sight-feed valves are placed in each pipe near the tank so that the supply may be shut off or regulated. As the engine is fully enclosed, no oil can be thrown on to the floor or into the governor wheel. With either system the valve gear is supplied with grease cups.



ASSEMBLED VIEW OF RIDGWAY SIDE-CRANK ENGINE.

Ridgway side-crank engines are built in the simple, tandem and cross-compound types. In the compound types the low-pressure valve is of the balanced type, though slightly modified from the one previously described. On tandem engines both valves are driven by the governor, the low-pressure directly and the high-pressure by means of a tail-rod on the low-pressure valve. On cross-compound engines the high-pressure valve is driven by the governor and the low-pressure by a fixed eccentric on the main shaft. Simple and tandem compound engines are made from fifty to 800 horsepower, and cross-compound engines up to 1,500 horsepower.

The New Westinghouse Distributing Transformers.

The Westinghouse Electric and Manufacturing Company has just developed and placed on the market a new shell-type distributing transformer, known as the Type "S" which has ben worked out from theoretical consideration a well as from the practical results of many tests. In these transformers the most economical disposition of all the material used has been made, and the result is a line of transformers of small dimensions, liberal overload, high efficiency, great reliability and good regulation. Use has been made of a new alloy of steel, and the design so proportioned that remarkably low magnetizing or no-load currents are secured.

Distributing transformers must at all times be ready to furnish electrical power up to their maximum overload capacity.

VIEW OF TYPE S DISTRIBUTING TRANSFORMER.

Interruptions of the service not only cause pecuniary losses to the power company but, worse still, are a source of friction between the consumer and the central-station manager. In cases where the central station is under contract to furnish continuous service to its customers an interruption of the service is a very serious matter.

The reliability of a transformer depends largely upon the disposition, quality and amount of insulating materials used in its construction. The insulation must not only separate the different turns of the individual conductors, but must also act as a barrier between the high and low tension coils and between either circuit and the core. A failure to fulfill these duties will result in a partial or complete destruction of the transformer, interruption of the service and very often danger to life and property. The presence of a very small amount of moisture in the insulation of a transformer will greatly reduce its dielectric strength. This is one of the most frequent causes of breakdowns, and often very disastrous results occur when only the slightest trace of moisture is present. To avoid troubles of this nature the insulation should be treated in such a manner as to make it impervious to moisture.

In Westinghouse Type S transformers the insulation is non-hygroscopic, that is, it will not absorb moisture, and will not deteriorate under ordinary operating temperatures. It undergoes a rigid inspection before being used in the transformer, and the assembled core and coils are further subjected to high breakdown voltages for the purpose of discovering any defects in the insulation.

A vacuum impregnating process is used to remove the last traces of moisture and to form the winding and insulation into a solid, moisture-repelling unit.

Insulation deteriorates under high temperatures, due to the carbonizing action which takes place in fibrous materials. A low operating temperature is therefore necessary for the satisfactory service of the transformer. By low operating temperature is meant not only low average temperature, such as would be indicated by a thermometer in the oil, but also a low maximum temperature, that is, at no point within the coils should the temperature rise much beyond the average temperature of the transformer. A transformer with hot spots is as much to be avoided as one having a high operating temperature.

The construction of shell type transformers such as the Type S permits of large ventilating ducts between the coils. Through these ducts the oil circulates freely and is thus enabled to reach the innermost parts of the apparatus. This oil circulation effectually prevents hot spots and maintains a uniformly low temperature throughout the transformer.

Good ventilation also enables a transformer to carry large overloads without a dangerous rise in temperature. If a distributing transformer has a large overload capacity, it may be installed to supply power considerably in excess of its normal rating, providing this power is only required at intervals and for a limited time. This not only saves the increased cost of a large transformer, but also gives a higher average all-day efficiency, due to the lower fixed losses of the smaller unit.

The electrical performance of distributing transformers should be carefully considered. Those having high losses are unsuitable for central-station work, and this is especially true in cases where the cost of the production of the power is high. The efficiency of a transformer depends upon the iron or core loss and the copper loss. These losses represent energy delivered to the transformer for which no return is received. The iron loss is of particular importance, since it is a continuous loss as long as the transformer is connected to the mains. This fact is well recognized and nearly all transformers show a reasonably low core loss when new. In many transformers, if the core loss is measured after having been in service about twelve months, it will be found that this loss has greatly increased, due to what is known as the "aging" of the iron. The magnetic circuit of the type S transformer is built of a special grade of alloy sheet steel, which has been selected only after an extensive series of tests proving it to have practically non-aging qualities.

TYPE S DISTRIBUTING TRANSFORMER, SHOWING COILS, TAPS AND CORE.

The regulation of a distributing transformer is a matter of prime importance both to the consumer and to the operating engineer. It depends principally upon the copper loss, and the per cent regulation is generally very little more than the per cent copper loss. If a transformer of zero regulation could be constructed and connected to the line the potential on the low-tension circuit would not change in passing from full load to no load. Distributing transformers should have as good regulation as possible. In type S

transformers the arrangement and size of the conductors provide for an especially good regulation.

All these transformers under twenty kilowatts are mounted in smooth cast-iron cases which have a cooling surface sufficient to keep the transformers at normal temperature. The cases for transformers of larger sizes are made of cast-iron with corrugated sides, which greatly increase the area of the cooling surface. The leads are brought out through porcelain bushings which are babbitted into the case. The lead insulation is moisture-proof, and a sealing compound is poured around the leads where they issue from the case.

The core is built up of laminated sheet-steel punchings, each layer of laminæ being reversed with reference to the preceding layer. This gives a continuous magnetic circuit of low reluctance. The full benefit of laminating the iron is thus obtained with a resulting low core loss. All iron used in the cores of these transformers is subjected to rigid tests and inspection at the factory. Samples taken from the iron used are tested for loss and aging, and only those giving satisfactory results are accepted. The assembled transformer is also tested to make sure that no inferior iron has passed the previous tests. The assembled core consists of four magnetic circuits encircling the winding and protecting it from mechanical injury.

Type S transformers have the high-tension winding mounted concentrically between two low-tension coils. All coils are form wound and individually insulated, the insulation consisting of those materials which long experience has shown to be the best suited to this work. The low-tension coils of transformers above five kilowatts are wound from cotton-covered strap copper having a rectangular cross-section; transformers of a smaller capacity have wire-wound low-tension coils. The high-tension coil is form wound of cotton-covered wire. The conductors are of circular cross-section in the smaller sizes but are of strap copper in the larger transformers.

Between the high and low-tension coils are layers of paper and mica. After the core and coils are assembled they are baked in a vacuum tank which removes every trace of moisture. A hot liquid insulating compound under high pressure is then introduced into the tank. This compound is oilproof at all temperatures. It does not dissolve in the oil, fill the ventilating ducts and cause the transformer to run hot.

The high-tension winding has four leads brought to the studs in the terminal block. Adjustable brass connectors or links between the studs provide for series or multiple connections between two points of the high-tension winding. The position of the studs and the length of the links are so proportioned that wrong connections on the block are impossible. Barriers on the porcelain block separate the studs and prevent danger of arcing.

The fuses furnished with these transformers are mounted in a weatherproof porcelain fusebox. The stationary contacts are deeply recessed in the porcelain and are well separated from each other. The contacts are so constructed that the plug is held securely in place by giving it a partial turn after inserting it. When the plug is in position the fuse is in sight and its condition can be noted; this eliminates all danger of pulling the fuse while intact and the transformer under load.

Connectors are supplied with all Westinghouse Type S transformers for connecting the low-tension leads to the feeder wires. These connectors for the larger sizes of transformers are of the interleaved type and form a mechanically strong joint of high current-carrying capacity. By means of these a change can be made in the low-tension connections of a transformer, or one transformer removed and another of the same or a different capacity substituted usually without unsoldering or soldering a joint.

Type S transformers are made in sixteen sizes, from one-half to fifty kilowatts, and are designed for normally supplying 110, 220, and, in the larger sizes, 440-volt service from primary circuits of 1,100 and 2,200-volt and sixty-cycle frequency, although they are suitable, without change in the rating, for any frequency from fifty to 140 cycles.

Union Switch and Signal Contract.

The Union Switch and Signal Company has received the contract for the protection by signaling and interlocking of the McAdoo tunnels.

At the terminal stations of these tunnels, at Church and Cortlandt streets, New York city, the signaling work will be the most important. The Switch and Signal company will install at this station at once four electro-pneumatic interlocking equipments, and also the intermediate block signals and train stops. The latter will be actuated by compressed air; the signals will be electrically operated.

RECENT IMPROVEMENTS IN LIFTING MAGNETS.

BY ARTHUR C. EASTWOOD.

The first commercial lifting magnet was placed in service in this country about thirteen years ago. This magnet was designed by S. T. Wellman for handling plates and slabs, and proved fairly satisfactory for such service. The design was later refined and improved upon by E. B. Clark, then electrical engineer for the South Works of the Illinois Steel Company.

The manufacture of lifting magnets of both the Wellman and Clark types was taken up by the Electric Controller and Manufacturing Company (then the Electric Controller and Supply Company) more than ten years ago. A special magnet-testing machine was designed and installed, and much valuable data bearing on the design of lifting magnets were secured.

Many magnets of the Clark type have been manufactured and sold, and have given excellent results in the handling of smooth, homogeneous material, such as plates, blooms and slabs. These magnets, however, were useless for handling rough and detached material, such as pig iron, crop ends and scrap. A magnet which would readily lift a steel ingot weighing 10,000 pounds would not lift a single pig of iron weighing 100 pounds.

Many attempts were made to perfect a magnet for handling pig iron and scrap, since, obviously, the large amounts of such raw material handled by tedious hand methods at all steel and iron works and foundries offered a tremendous field for the saving of labor, providing a practical lifting magnet could be developed for the purpose.

Perhaps the first experiments in this direction which gave promise of commercial results were made at the West Seneca plant of the Lackawanna Steel Company, under the direction of E. D. Edmondson and L. R. Palmer, a lifting magnet being constructed which actually lifted pig iron, though in rather small quantity, taking into consideration the weight of the magnet and its current consumption.

The first commercially successful lifting magnet for handling pig iron, scrap and miscellaneous magnetic material was placed on the market by the Electric Controller and Manufacturing Company in March, 1905. This magnet was built in two sizes, commercially known as No. 1 and No. 2 Type S magnets. Over 150

of these magnets have since been placed in service, and, at a conservative estimate, have saved to the iron and steel trade of this country at least half a million dollars in the cost of handling material within the past year. This type of magnet has also been introduced in Germany and England.

In view of these facts, there can be no doubt that Type S magnets, as manufactured by the Electric Controller and Manufacturing Company, have become satisfactory and reliable tools—more dependable, in fact, than the cranes which carry them. This company, however, has not been content to rest upon the satisfactory results thus far obtained with its Type S magnets, but has been constantly at work on improvements, both in the direction of dependability and in increased efficiency in the handling of material.

Unquestionably, a successful lifting magnet must withstand in service more severe abuse and rough handling than any other type of electrical apparatus. In operation it is suspended from the hook of a crane (frequently not equipped with a lowering brake), and may be dropped at high speed upon the material to be lifted, which may be comparable almost to dropping the magnet from a second-story window. In service it will be swung against cars, charging boxes, piles of pig iron, etc., and must be capable of withstanding the blows and shocks which result. It must operate under all weather conditions, day or night, irrespective of rain or snow, and its insulation must withstand a voltage much higher than line voltage, due to the inductive kick which occurs when the circuit of the magnet is opened. Its winding must not be injured by the large amount of heat which is necessarily generated within it, and, preferably, also, should not be damaged by external heat when the magnet is called upon to handle hot material.

Fig. 1 is a typical cross-section of a Type SA magnet, and shows the arrangement of parts which by experience has been found to meet the severe and exacting requirements of service.

In Fig. 1, A is the body or framework of the magnet, which is an annular casting of special electrical steel heavily ribbed on both its upper and outer surfaces. The ribs serve to add largely to the surface available for dissipating heat, and are so disposed as to stiffen the magnet case mechanically and at the same time to add to the cross-section of the magnetic circuit.

B is the core of the magnet, which is surrounded by the winding C. This winding is composed of a series of coils, each wound with a conductor in the form of a copper ribbon or strap, the turns of which are insulated with asbestos ribbon. Neighboring coils are mechanically separated and electrically insulated by non-combustible insulating discs D. The coils are wound upon a heavy brass form E, which resembles a spool with one head removed. This form serves to support the coils during the process of winding and insures coils of uniform and perfect shape, since there is no danger of springing or otherwise distorting the winding. After the last or uppermost coil is wound and the outer disc of insulation is in place, the entire winding is rigidly clamped to the form by means of radial straps F, which are bolted and locked in place, thus making the winding and the brass form which carries it a rigid unit. The completed winding is then dried in a steam-heated chamber under a vacuum, and when the initial drying process is completed the winding is impregnated with a plastic insulating compound, first, under the influence of a vacuum and then under air pressure and finally is again dried under a vacuum. This results in a winding not only fireproof—not a particle of combustible material being used in its make-up—but, what is of still greater importance, the winding is thoroughly waterproofed. The completed winding is then placed in the magnet case.

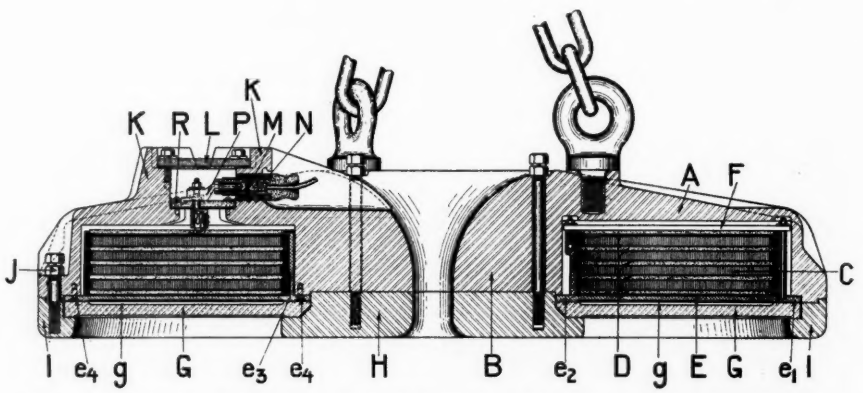
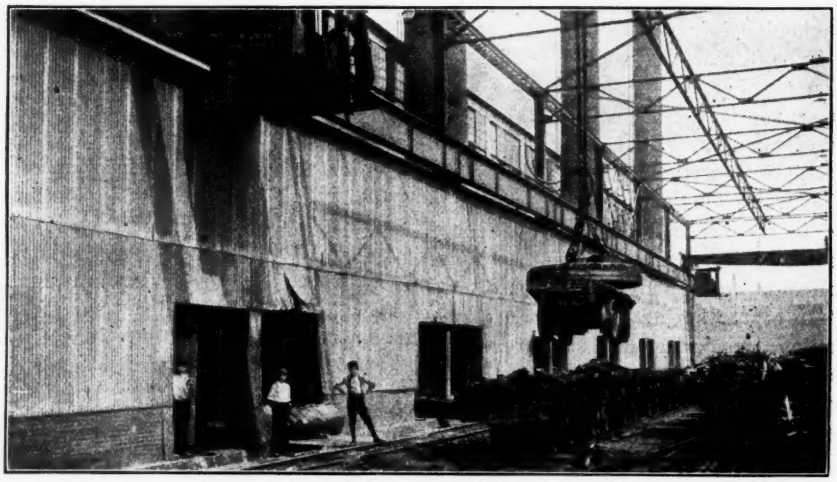


FIG. 1.—SECTIONAL VIEW OF ELECTRIC CONTROLLER AND MANUFACTURING COMPANY'S TYPE SA LIFTING MAGNET.

It will be noted that the form E is provided with an outer flange *e*1, and an inner flange *e*2, in addition to the central upwardly-extending flange *e*3, which centrally supports the winding. The inner and outer flanges are carefully finished and engage with finished surfaces on the inner and outer pole faces of the magnet case, thus completely sealing the lower face of the winding chamber, a watertight joint being insured by clamping the flanges in place with screws *e*4, *e*4, spaced four inches apart, entirely around the flanges *e*1 and *e*2. Since the winding is clamped to the form E by the radial clamps F, and the form E is clamped in the magnet case by screws placed four



NO. 6 TYPE SA MAGNET LIFTING BUGGY WEIGHING 70,000 POUNDS BY LINE CONTACT WITH SPACING RIBS—CARNEGIE STEEL COMPANY, HOMESTEAD, PA.

inches apart entirely around its inner and outer edges, it will be readily seen that the winding is rigidly held against displacement.

With the winding thus assembled in the magnet case, the lower face of the coil form E is covered by a heavy annular plate of non-magnetic manganese steel G, which in turn is held in place by pole shoes H and I, bolted, respectively, to the inner and outer poles of the magnet case. Both of the pole shoes are provided with shoulders which protect the clamping bolts from shearing strains. The heads of the outer clamping bolts J are located between adjacent ribs on the outer surface of the magnet case, where they are protected from abrasion.

In the cross-sectional view it will be noted that the manganese steel plate G carries raised shoulders around its inner and outer peripheries, by means of which the plate is made to seat against the magnet poles, and an air space or cushion is left under the winding at *g*. This results in the shocks taken by the outer plate G being transmitted directly to the magnet frame instead of being taken by the winding, as would necessarily be the case if only a single-bottom plate were used.

The pole shoes are so disposed with respect to the outer plate G that none of the clamping surfaces can become battered over, and, therefore, the plate G may always be readily renewed.

It will be seen that the entire lower or wearing face of the magnet is renewable, and that these renewals can be readily effected in the field, there being no necessity of in any way exposing or disturbing the winding or breaking the watertight joint between the coil form E and the frame of the magnet.

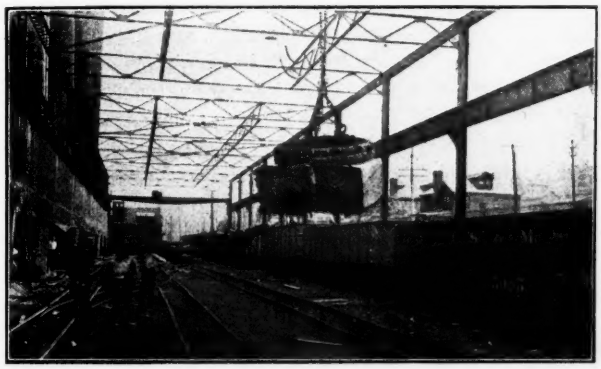
The arrangement of terminals also deserves attention, since, no matter how good the design in other respects, if the terminal construction be weak, trouble is certain to result from this cause.

In Type SA magnets the terminal cavity is surrounded by raised walls K, K, cast integral with the magnet case and of such thickness as to be as strong as the magnet case itself. The terminal cavity is closed at the top with a heavy steel cover L, which seats against a gasket to form a water-tight joint, and is firmly bolted in place, the heads of the bolts being protected from abrasion by the walls of the terminal cavity. All of the terminal parts are thus enclosed in a waterproof box of steel. The terminals themselves, as in the earlier Type S magnets, are of the plug type, which permits of quick attachment and detachment of the service wires. Numerous improvements, however, have been made in the details of construction. The female members M of the terminal are enclosed in an insulating tube, so that a ground or short-circuit cannot result, even if the service wires are left hanging from the crane with current on. The insulating tubes are each encased in a steel tube to prevent abrasion of the insulation, and these steel tubes fit closely in babbitted openings N in the side of the terminal chamber. The male members P of the plug connectors are mounted upon a heavy plate R of fireproof insulating material, which closes the entrance to the winding chamber and is seated upon a gasket to effect a watertight joint. The plugs proper are separable from the terminals by removing the nuts which hold them in place. The plugs and also the plate R may therefore be removed without throwing any strain on the connections to the winding, the connections consisting of loops of very flexible copper ribbon, these loops being stowed away in the box-like ends of the terminal studs. This construction permits of great flexibility and at the same time makes it impossible for the flexible leads which connect to the two ends of the magnet winding to come into accidental contact. These features of construction indicate how carefully the design of Type SA magnets has been thought out and worked out from a mechanical and electrical standpoint.

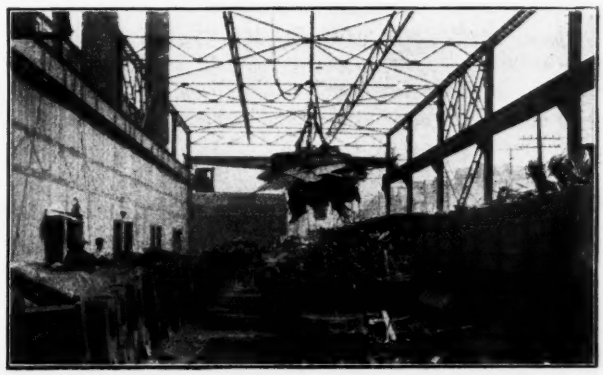
In additon to these structural features the Electric Controller and Manufacturing Company has incorporated in the design of Type SA magnets the results of long experience and careful study.

By maximum efficiency is meant the ability to handle the largest amount of material in a given time with minimum total consumption of current. In this respect the results obtained with Type SA magnets far surpass any results which have been obtained in the past. As an instance, the No. 4 Type SA magnet, forty inches in diameter, lifts substantially as much as older forms of magnets of fifty inches in diameter with substantially the same current consumption, but weighs 2,000 pounds less. Comparing the performance of the two magnets on a five-ton crane having a twenty-five-horsepower hoist motor, with equal lifts, the No. 4 SA magnet has the advantage of 2,000 pounds in total load to be lifted, or twenty per cent of the total hoisting capacity of the crane. This will mean a saving in current consumption of twenty amperes on the part of the hoist motor, and by virtue of this lower current consumption and lighter load, the hoisting speed will be higher and the amount of material handled in a given time will be materially increased.

Proportionate increases in efficiency are shown by the No. 5 and No. 6 Type SA magnets, the No. 6 magnet being without question the most powerful commercial lifting magnet which has ever been constructed.



NO. 6 TYPE SA MAGNET HANDLING TWO INGOT BUTTS, NOT WEIGHED—CARNEGIE STEEL COMPANY, HOMESTEAD, PA.



NO. 6 TYPE SA MAGNET HANDLING SHEET SCRAP, WEIGHT 1,200 POUNDS—CARNEGIE STEEL COMPANY, HOMESTEAD, PA.

Advertising with Flame Arc Lamps.

The first flame arc lamps used in this country were of foreign manufacture. It was, however, only a comparatively short time after their introduction that American manufacturers awoke to the realization that the lamp was destined to play an important part in decorative lighting. The result was that at the present time there are several American-made lamps on the market, all of which are widely advertised.

Although in foreign countries the flame arc lamps has been widely adopted for street illumination, its use in this country is confined principally to the illumination of store fronts and amusement places such as theatres, parks, etc. While its use in connection with mercantile establishments is principally to attract attention, it can at the same time be used to advantage for the illumination of the store windows, thus serving a double purpose. For this service the lamps are suspended from suitable supports just above the top of the window.

To the brilliant light emitted by the flame arc lamp when in operation is due its advertising or attention-attracting quality. The entire globe seems filled with a luminous gas, and, although the light has the property of penetrating the thickest fogs or smoke, it is soft and not blinding to the eye like the enclosed arc. Carbons giving a yellow or orange colored light are generally used, but carbons may be obtained that will give a light of a red or white color.

Fig. 1 shows the front of a department store in Schenectady, N. Y., lighted with four flame arc lamps of a type manufactured by the General Electric Company, Schenectady, N. Y. This illustration was reproduced from a photograph taken solely by the light of the lamps, and although it fails to show the true beauty of the illumination, gives an idea of how the store appears at night. This is only one of many similar installations in this city, and it is interesting to note that the merchants have clubbed together and made arrangements to have the entire business section lighted with G-I flame arc lamps. The lamps will be spaced at equal intervals along both sides of the street and at the same height from the sidewalk.

In Fig. 2 is shown an exterior view of the lamp. In this type of lamp several good points of construction may be noted. All clock mechanism is eliminated, thus producing a lamp of simplicity and one free from the troubles common to more complicated lamps. Instead of the carbons being placed one above the other, as in the ordinary arc lamps, they are placed at such an angle that they form a V, the arc forming at the lower end. All of the light is directed downward, and

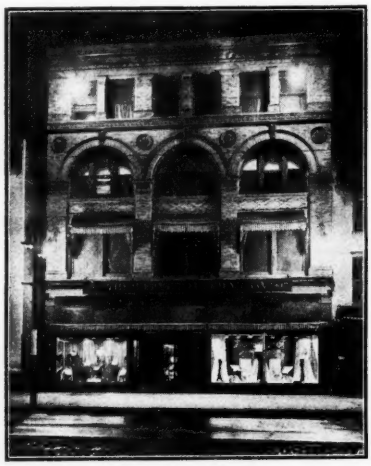


FIG. 1.—BUILDING ILLUMINATION WITH G.-I. FLAME ARC LAMPS.

the absence of any obstruction below the arc prevents shadows being formed. The carbons are fed in such a manner that flickering is prevented and it is impossible for one of them to slide past the other and cause the lamp to go out. Every part of the mechanism is accessible when the

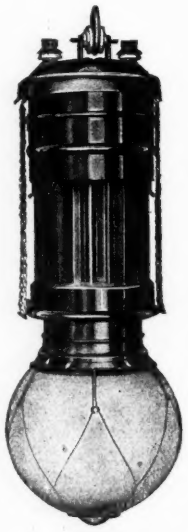


FIG. 2.—G.-I. FLAME ARC LAMP.

casing is lowered. As regards efficiency, the company states that this type of lamp takes less power per unit of illumination than any other illuminant in commercial use.

In designing the lamp special attention has been paid to its external appearance. The shell is made of copper or steel and finished in antique copper or bright japan. The globe is not held by the wire network, but is securely fastened by a flange and ring at the top, the net being retained to prevent the glass from falling should the globe be broken. The entire length of the lamp is only thirty-one inches.

These lamps operate satisfactorily either in series or in multiple on alternating or direct-current circuit and will burn any approved make of flame carbons now on the market.

Proposed Car-Lighting Combination.

An effort is being made, it is stated, to consolidate the United States Light and Heating Company, which was formed to manufacture electric-lighting apparatus for passenger trains, with other concerns doing a similar business. The New York Stock Exchange house of Hooley, Learnard & Company is interested in the proposed consolidation, and is reported to be now engaged in obtaining options on a controlling interest in the United States Light and Heating Company.

About two years ago this company passed under the control of interests identified with the New York Air Brake Company, Charles A. Starbuck, president of that company, becoming president of the United States Light and Heating Company. About the time that Mr. Starbuck was elected president of the United States Light and Heating Company, C. H. Chaffee, now assistant treasurer of the New York Air Brake Company, was made the lighting company's general manager. At the same time Edwin Hawley was named as vice-president. Besides these, the list of officers and directors of the company included A. S. Adler, Charles G. Smith, Charles S. Furst, John J. Moore and W. S. Crandell.

The system of lighting in which the United States Light and Heating Company is interested is known as the Moskowitz system, which employs power generated directly from the axle of passenger cars.

In 1903, the year after the company's organization, William J. Arkell was president of the company, and among the directors were Chauncey M. Depew, Joseph Leiter and Leroy W. Baldwin. The capital of the company from $3,000,000, the figure at which it stood in 1903, was increased to $6,000,000, divided into shares of the par value of $10.

Current Electrical News

GREAT BRITAIN.

LONDON, NOVEMBER 20.—It is interesting to note that in the midst of a prolonged controversy over the efficiencies of surface-contact systems in Great Britain, the Lorain system, which is of American origin, stands quite alone in having demonstrated its reliability above all others. The experiment in London with the "GB" surface-contact system has developed a further stage this week in that the London County Council, acting upon the advice of the president of the Institution of Electrical Engineers, has decided to spend $2,500 more in certain amendments to the car equipments. Although Mr. Mordey's report is not to be made public, from what is known there is a strong suspicion that it criticizes the car equipments. It was this portion of the work, which was in the hands of the Council's officers, about which the "GB" surface-contact company complained when it was decided last July temporarily to cease working the line in the Mile End Road. In this same connection, a lively discussion has been going on at Oxford, where the municipal corporation arranged, a few years ago, with another company to install the Dolter surface-contact system. This system is still in operation in Torquay and Hastings, having been supplanted by the overhead-trolley system at Mexborough in Yorkshire, but after having seen the operation at the first two places, the Oxford corporation was not satisfied as to the suitability of the system and has refused to allow it to be installed.

In connection with a proposal for new capital, the London Electrobus Company has issued a statement showing that during the fifteen months of its existence it has created a record in 'bus receipts, its average having been twenty-eight cents per bus-mile, compared with about twenty-four cents on the London tramways and sixteen cents on the petrol buses. The buses are now said to be earning a profit of $2,250 per month, which leaves a considerable margin for dividend after meeting establishment and overhead charges, debenture interest and depreciation. The new capital is to take the form of six per cent debenture stock.

Following the rejection by Parliament of the bulk electricity-supply scheme for London, the committee is now wrestling with the many conflicting interests arising out of the proposal by the Board of Trade that the London County Council shall be constituted the purchasing authority in 1931, in the place of the various borough councils. Today feeling ran so high that the companies threatened to withdraw the bill and so upset all the plans of the Government, but after consultation with the government authorities, the committee chairman said that such a course of procedure would not be allowed.

It is a popular saying that the best way to shelve a matter is to relegate it to a royal commission. The royal commission on London traffic reported several years ago, but so far no action has been taken to put into effect its recommendation that a special traffic board for London should be elected. This week, however, the prime minister has agreed to receive a deputation from the London County Council on the question. It is of interest to note that since the royal commission on London traffic concluded its sittings, twenty-six and one-half miles of new tube railways have been opened, eighty miles of new electric tramways have been constructed in the outer area and twenty-eight and one-half miles in the county of London; electric traction has been substituted for steam traction on sixty-eight miles of railway, and the northern and southern tramway systems have been linked; and all without a guiding authority to see that there is no waste in the duplication of means of transit, etc.

Systems of charging for electric supply are exercising the minds of engineers in this country to a considerable extent, especially since it has become to be regarded as part of an electric-supply engineers' training that he should have the commercial instinct developed to an even greater degree than his engineering capabilities. The reverse was the case until comparatively recently. So important is this matter regarded, that the Institution of Electrical Engineers, although it devoted a large portion of its time last session to the subject, is opening its new session next week with a paper on a similar subject. G.

EASTERN CANADA.

OTTAWA, NOVEMBER 28.—The town of Pembroke, Ont., has passed a by-law providing for the installation of electric pumps for the waterworks system of the town.

The gross earnings of the Shawinigan Water and Power Company for the ten months of the current fiscal year have increased about seventeen per cent, the total for that period being $563,679, as compared with $476,844 for the corresponding period of last year.

The English interests which contemplate putting through the Mexican Power Company's lease to the Mexico Tramway Company over the heads of the directors of the former company, are overwhelmingly in control of the power company and have English proxies, it is said, for no less than 100,000 shares out of 160,000 shares.

Announcement has been definitely made that a merger of electrical interests has been consummated in London, England, whereby Mr. William MacKenzie secures control of the Toronto Electric Light Company, which will consolidate that company with the Electrical Development Company and the Toronto & Niagara Power Company.

The Canadian Postmaster-General, Hon. Rudolph Lemieux, is in London, England, continuing his inquiries regarding a state-owned Atlantic cable. Mr. Lemieux does not admit or deny that he possesses cabinet authority to complete a bargain with the British and Australian Governments, but he says the idea of a state-owned cable is much approved on both sides of politics and among the press, and there is no question that it would also prove a financial success. The minister is also inquiring about government ownership of inland telegraph service in England.

During the first part of December work will be commenced on the building of the proposed bridge across the Niagara River, of the Trans-Niagara Bridge Company. With the completion of this bridge, the International Railway, the Niagara, St. Catherines & Toronto Railway, and the Hamilton, Grimsby & Beamsville Railway companies will be consolidated and the broken links in the trolley system between Niagara Falls and Toronto completed. The new bridge will be exclusively for electric-railway traffic.

A couple of years ago tests were made of electric smelting of iron at Sault Ste. Marie by the Dominion government. As soon as the results of these experiments appeared, a Swedish firm of ironmasters began constructing furnaces, and after two years seems to have achieved success. The furnace at Dumnarfvet was to be started on December 1. Dr. Haanel, the Canadian Government's expert, had been invited to be present and recently left for Sweden to report upon the matter. It is learned that the new furnace is a great advance upon previous efforts. It will use 800 horsepower instead of 250 horsepower employed at the "Soo" tests. The cost of the product under the Swedish process will be only $12 a ton. With the electric process ore with the admixture of two-and-one-half per cent of sulphur can be handled. W.

WESTERN CANADA.

WINNIPEG, NOVEMBER 28.—Although the civic electric street-car system in Edmonton, Alb., has been in operation for less than a month the people are already drawing up a petition for cars to be run on Sundays. At the last session of the Alberta Legislature an act was passed prohibiting the operation of street-railway systems on the Sabbath, despite the fact there was not then a street-railway system in the whole province. An effort will be made to have this law repealed.

Troubles are not coming singly at Port Arthur, Ont., as far as the civic electrical interests are concerned. Last week the street-car controversy was brought to a climax when the system was seized by the sheriff and handed over to a joint commission for operation while the matter is being thrashed out in the courts. The feature for this week is the announcement that the Kaministiquia Power Company, a corporation from the sister city of Fort William, will compel Port Arthur to live up to the contract for the supplying by the company of electrical power, which contract has been canceled by the city on the grounds that the company was using the contract as a leverage with the Ontario Government to obtain power privileges at Dog Lake Falls, where the city is also seeking power privileges.

The ratepayers of the municipality of Saskatchewan, Man., will shortly vote on the question of installing a municipal telephone system. The two adjoining municipalities have systems and it is practically certain that the Saskatchewan municipality will also build a system. Address Councilor John Hunter, Rapid City, Man.

J. L. Nelson, of Winnipeg, has received the contract to supply the Manitoba Telephone Commission with 25,000 telephone poles, which will be delivered during the present winter.

The British Columbia Electric Street Railroad Company will build twenty-four cars at its New Westminster shops, having large platforms that can be fitted up as pay-as-you-enter cars if the system proves successful locally. R. H. Sperling, Vancouver, B. C., is general superintendent of the company.

Tenders are being called by the city of Winnipeg, Man., until December 28 for various work in connection with the civic power plant at Lac du Bonnet. Tenders are being asked for the general work at the power site; the erection of the transmission line from the power site to Winnipeg, a distance of approximately 66.5 miles; the necessary steel towers, and electric transmission cables. Plans and specifications of these works, also forms of tender, may be obtained at the office of the Power Engineer, Carnegie Library Building, Winnipeg, Man., and also at the office of Smith, Kerry & Chace, consulting engineers, Confederation Life Building, Toronto. In discussing the proposed work C. B. Smith, the expert retained by Winnipeg, has announced the plant will be in operation during 1910 if progress is made as proposed.

At a recent meeting of the City Council of Fernie, B. C., it was decided to call for tenders for a 260-horsepower gas-producer plant providing satisfactory arrangements can be made with the Crow's Nest Pass Electric Light and Power Company. Tenders are now being called under these conditions until noon, December 15, and are receivable by A. A. Sharley, acting city clerk, who can also show plans and specifications.

Tenders will be received by Magnus Peterson, secretary of the civic board of control, until February 22, for the supply and erection of a turbine pump and motor for the city water works. Plans and specifications may be seen at the office of H. N. Ruttan, city engineer, Winnipeg, Man.

At Saskatoon a committee has been appointed consisting of R. Smith, M. Mansell and several others, to petition the government to construct telephone lines along the railways both east and west from that city. R.

At Hedley, B. C., the Hedley Power and Development Company has been organized to furnish electricity to a number of the mines in the neighborhood. L. H. Patton has been elected secretary of the concern and 2,000 inches on the Similkameen River has been applied for and a power site selected. Active construction will be commenced as soon as the water rights are granted.

The City Council of Victoria, B. C., is seeking rights from the Provincial Government to develop and distribute electric power, and if these rights are granted will enter into competition with the British Columbia Electric Company.

The ratepayers of McLeod, Alb., will shortly vote on a by-law to raise $35,000 by the sale of debentures for enlarging the civic electric-light and power plant. To date this plant has met all demands, but owing to the rapid growth of the city enlargement is necessary. These debentures will be repayable during a period of forty years. Address E. F. Brown, secretary treasurer.

IMPORTANT DEVELOPMENTS.

TWENTY-FIVE-YEAR CONTRACT FOR 25,000 HORSEPOWER CLOSED BY ST. PAUL RAILROAD—The Chicago, Milwaukee & St. Paul Railway Company has closed a contract with the Great Falls Water Power Company, of Helena, Mont., for the supply of 25,000 horsepower for twenty-five years. C.

CHICAGO AND MILWAUKEE ELECTRIC RAILROAD MORTGAGE TO BE FORECLOSED—On November 27 the attorney representing the bondholders' committee of the Chicago and Milwaukee Electric Railroad filed a bill in the United States Circuit Court at Chicago asking for the foreclosure of the mortgage on the Illinois section of the road. A similar suit relating to the Wisconsin corporation was filed a week previously. It is believed that the system will be bought up by the bondholders at the foreclosure sale and a reorganization effected that will terminate the financial entanglements of the properties.

CHICAGO CITY RAILWAY COMPLETES ITS BOND ISSUE—The Chicago City Railway Company has sold $6,000,000 of its first mortgage five per cent bonds to the Illinois Trust and Savings Bank. With the previous issues of $12,000,000 this completes the $18,000,000 of bonds authorized for rehabilitation purposes by the new traction settlement ordinance. The expenditures permitted from the proceeds of the bond issue are all carefully checked by the Board of Supervising Engineers. Considerably over half of the rehabilitation work assigned to the company has been completed in less than half the specified time.

SULTAN OF TURKEY REMOVES BAN ON TELEPHONES IN EMPIRE—The Turkish government is looking for someone who will undertake the installation of a complete telephone system throughout the empire, according to a communication sent to the Department of Commerce and Labor by Vice-Consul General Heizeer, from Constantinople. Soon after the establishment of a constitutional government in the Ottoman empire, an order was issued abolishing the former regulations prohibiting the telephone. Now the Turkish government announces that it will receive bids on a complete telephone concession for the entire country during the month of December.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY SELLS $50,000,000 BONDS—The American Telephone and Telegraph Company has sold $50,000,000 of its four per cent convertible gold bonds to a syndicate consisting of J. P. Morgan & Company; Kuhn, Loeb & Company; Kidder, Peabody & Company, and Baring Bros. & Company, Limited, of London. These bonds are identical with the $100,000,000 issue sold to the same bankers in 1906. This sale completes the authorized issue of $150,000,000 of these bonds and fully finances the company for the years 1909 and 1910, including provision for the $6,000,000 Western Telephone and Telegraph notes, due in May, 1909, and $25,000,000 American Telephone and Telegraph notes, due in January, 1910.

BEGIN SURVEYS FOR PHILADELPHIA-CAMDEN TUNNELS UNDER DELAWARE RIVER—Actual work on the tunnels under the Delaware River to connect Camden, N. J., with Philadelphia has been begun, a corps of civil engineers having commenced the surveys on both shores. This was announced by W. A. Stern, of Stern & Silverman, the railroad contractors, who will have charge of the work, the cost of which is conservatively estimated at $7,500,000, but which may aggregate nearly twice that amount before the task is completed. The method of construction will follow very closely that used by the Pennsylvania Railroad in building its tunnels under the North and East rivers in New York. They will be excavated by the

"shield" method, which involves the forcing of an immense steel section ahead of the big force of men that will be required in removing the earth.

BOSTON'S NEW MILE OF SUBWAY COSTING $10,000,000 TO BE OPENED—Excellent progress is being made on the new subway under Washington Street, and the Boston Elevated Company expected to be running cars in the tunnel before December 1. The length of the new subway is 5,676 feet, and the construction and equipment have cost over $10,000,000. The platforms are 350 feet long, and the addition to the road is expected to increase the carrying capacity 175 per cent. The new tunnel has been made absolutely fireproof. The lighting is by incandescent lamps, arranged behind beams of the arched ceilings. To insure a perfect supply of fresh air in the tunnel there are four fan chambers, each fan being capable of exhausting 25,000 cubic feet of air per minute. The foul air is drawn out in the tunnel between stations, through ducts constructed in the concrete ceilings. The fresh air enters at the several stations, the entrances of which are open save for an ornamental grille work.

TELEPHONE AND TELEGRAPH.

McCALLSBURG, IOWA—A new switchboard will be installed in the telephone building at McCallsburg. C.

OAKWOOD, OKLA.—The Oakwood Telephone Company has been incorporated with a capital stock of $750. P.

MERCEDES, TEX.—The Mercedes Telephone Company has been incorporated with a capital stock of $1,000. P.

IOWA CITY, IOWA—The Johnson County Telephone Company contemplates spending $35,000 on improvements. P.

BARTLETT, TEX.—The Bartlett & Donahoe Telephone Company has been incorporated with a capital stock of $300. P.

KINGSLEY, IOWA—The directors of the Kingsley Telephone Company have decided to install a new switchboard in the exchange at Kingsley. C.

FRANKLIN, PA.—The Bell Telephone exchange at Franklin was destroyed by fire, entailing a loss of $35,000, part of which is covered by insurance.

OLYMPIA, WASH.—The United Wireless Company is arranging equipment for a receiving station, using the dome of the state capitol as a mast.

OLYMPIA, WASH.—The Uniontown Telephone Company, of Uniontown, has been incorporated with a capital stock of $5,000 by Lambert Taufen, W. W. Miller and George A. Dressel.

PORTLAND, ME.—All the property rights, franchises, privileges and appurtenances of the Northeastern Telephone Company will be sold at public auction, December 16, by Frank E. Ebersole, as special master, by a decree of foreclosure.

OMAHA, NEB.—The Independent Telephone Company is contemplating putting in $1,000,000 worth of extensions and improvements. It is the intention to develop exchanges simultaneously at Benson, Florence, Dundee and South Omaha.

FOND DU LAC, WIS.—Articles of incorporation have been taken out for the organization of the Eldorado & Friendship Telephone Company, the capital stock being $5,000. The incorporators are: John Reilly, W. H. Keyes, W. C. Pay, L. G. Barnes and W. T. Reilly.

VALLEJO, CAL.—The new switchboard recently installed by the Western Electric Company, of Chicago, in the exchange of the Pacific Telephone and Telegraph Company, at Vallejo, was successfully cut over recently, and the town has now one of the most modern exchanges in the country.

ROCHESTER, N. Y.—Reorganization and merging of all seven Bell telephone companies operating in New York state is under way by the American Telegraph and Telephone Company, and on or about January 1 the merger will become a fact. A holding company will be the vehicle for carrying the control of the companies. The total capitalization of the seven companies is now $89,585,200.

PERSONAL MENTION.

MR. JOHN T. MORRIS, of Columbus, Ohio, has been engaged by the Canal Dover Board of Public Service as designing engineer and superintendent of construction for the municipal electric light plant which will be erected in that city.

MR. GRANT W. SPEAR, who for many years has been vice-president of the Dearborn Drug and Chemical Works at Chicago, has taken charge of the general eastern offices of the company at 299 Broadway, New York city, as vice-president and eastern manager.

MR. JOHN MUSTARD, of the Wagner Electric Manufacturing Company, has been appointed assistant manager of sales for the territory inclusive and east of Pittsburg, with headquarters in Philadelphia. Mr. Mustard has been with the company as district manager at Philadelphia for the past fifteen years.

MR. MELDON H. MERRILL, who, as salesman for the Westinghouse Electric and Manufacturing Company, has been active for some years past in promoting the introduction of electric drive among the textile mills in New England, has recently resigned his position with that company, taking up similar work in connection with the Boston office of the Allis-Chalmers Company.

MR. THOMAS GRAHAM GRIER, of Chicago, president of the Grier Company, manufacturers' agent, and author of the book "On the Canal Zone," recently favorably reviewed in this paper, delivered an illustrated lecture on "The Panama Canal and Life on the Canal Zone," before an audience at the auditorium of the Hyde Park Young Men's Christian Association, Chicago, Thanksgiving night.

MR. GEORGE A. POWELL, of Winnipeg, who has been associated with the Packard Electric Company, Limited, of St. Catharines, Ont., for the last fifteen years, has severed his connections with that company. He has started business for himself in the electrical line as commission broker, with offices in the Union Bank Building, Winnipeg, Man. He will continue to represent, among other agencies, the Eugene F. Phillips Electrical Works, Limited, of Montreal, well-known makers of bare and insulated copper wires and cables.

MR. J. R. GORDON has accepted the position of manager of power apparatus sales for the Western Electric Company for its southern territory. He will continue to make his home in Atlanta, Ga. He resigned a month ago from his position of manager in the Southern States for the Westinghouse Electric and Manufacturing Company. Mr. Gordon is known throughout the country as a pioneer in the electrical field, having been associated with those who organized and operated the first of the Edison plants. For many years he has been a prominent member of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers.

MR. KARL LAURELL, a draftsman at the Lynn, Mass., works of the General Electric Company, has sailed for Sweden, where he will soon begin duties as general superintendent of the Stockholm Electric Supply Company. Mr. Laurell has been in this country for less than two years, and during that time has been connected with the General Electric Company, where he has been studying American systems in the production of electrical supplies. He is twenty-six years of age and was born in Upsala, Sweden. Laurell attended the Royal College in Stockholm, where he took a thorough electrical course, and after finishing came to this country for practical experience.

MR. W. B. McVICKER, resigning as vice-president and eastern manager of the Dearborn Drug and Chemical Works, with which he has been connected for many years, has incorporated the W. B. McVicker Company, with offices in the United States Realty Building, 115 Broadway, New York. A new and complete laboratory and factory is being built to have exceptional facilities for general analytical work and the manufacture of high-class products, and a specialty will be made of high-grade lubricants and scientific preparations for treating boiler feedwaters and hydraulic systems. The personnel of the company includes Charles M. Eddy, Albert E. Carpenter, Joseph F. Hammill, William J. Schatz, G. Frank Duemler and Frank J. Zink.

ELECTRIC LIGHTING.

WOMBLE, ARK.—The Bear State Lumber Company will install an electric-light plant at Womble. P.

ALVIN, TEX.—E. B. Hill has been granted a twenty-five-year franchise for an electric-light plant.

SEATTLE, WASH.—The Coast Lighting Company has been incorporated with a capital stock of $25,000.

HINCKLEY, MINN.—The dam of the Hinckley Electric Company has gone out entailing a loss of $1,000. C.

ROCHESTER, MINN.—Rochester contemplates issuing bonds for from $50,000 to $75,000 for a lighting plant. P.

RUTHERFORD, N. J.—The Borough Council has passed a resolution to advertise for bids for street lighting.

MERCEDES, TEX.—The Mercedes Electric Light Company has been incorporated with a capital stock of $2,000.

MONTEREY, TENN.—Monterey is to have an electric-light plant and bids are now being taken for the contract.

VAN BUREN, ARK.—W. R. Petty, of Pine Bluff, Ark., contemplates establishing an electric-light plant in Van Buren. P.

YORK, PA.—The Peach Bottom Electric Transmission Company, of York, has been incorporated with a capital of $5,000.

SABINAL, TEX.—The Sabinal Water and Ice Company has increased its capital stock and will build an electric-light plant. P.

WEATHERFORD, OKLA.—Twenty-five thousand dollars in bonds has been voted for the construction of an electric-light plant.

BROWNS VALLEY, MINN.—It is proposed to dam the Little Minnesota River near Browns Valley, securing power to operate an electric-light plant. C.

FAIRVIEW, OKLA.—Fairview will install an electric-light plant which will cost $10,000. The plant may be finally owned by the city on an option.

JOLIET, MONT.—Work is about to commence on an electric-light and gravity water system, which Norman S. Poole, engineer, has been promoting, at Joliet. C.

ESCANABA, MICH.—A second power dam, capable of furnishing 25,000 horsepower, will shortly be constructed across the Escanaba River near Groos, Mich. C.

NEW CASTLE, IND.—The Maxwell-Briscoe Motor Company will erect and install a combined water and electric-light plant for its large factory at New Castle. S.

KANSAS CITY, MO.—The main power plant of Swift & Co.'s packing house was destroyed by fire shortly before midnight, November 27. The loss was $40,000.

MONDOVI, WIS.—The Mondovi Light and Power Company has been incorporated with a capital of $35,000 to own and manage two mills and an electric-light plant.

MOUNT AYR, IOWA—The Mount Ayr Light and Power Company, of which W. Jackson Bell is secretary and general manager, has been incorporated with a capital of $20,000. C.

ST. CLOUD, MINN.—The Union Power Company expects to have its power station at the east end of the mill canal at St. Cloud completed and the water turned on December 15. C.

LOUISVILLE, KY.—The Kern Electric Company has been incorporated in Daviess County with a capital of $6,000. W. J. Kern, E. L. Holbrook and C. G. Kern are the incorporators.

DANVILLE, IND.—The Danville Light, Heat and Power Company has increased its capital stock from $36,000 to $100,000. It is proposed to improve and enlarge the plant and install new machinery. S.

LAPORTE, IND.—The managers of the electric plant of the Laporte Public Utility Company, which was recently destroyed by fire, have given out that the plant will be rebuilt and new machinery installed at once. Otto Wettstein is secretary and manager.

REDWOOD FALLS, MINN.—R. F. Wherland is working on a scheme to develop the waterpower of Redwood Falls, Minn. A stock company with a capital of $100,000 is being organized for the purpose. C.

JEFFERSON CITY, MO.—The American Light and Power Company, of Union, has been incorporated with a capital stock of $10,000, by W. W. McCurdy, C. P. Reinhard, L. W. McCurdy and others.

TONOPAH, NEV.—The Rhyolite Electric Company has filed letters of incorporation, with W. D. Hatton, C. A. Stoible and M. J. Hill, all of Goldfield, as directors. The capital stock is placed at $100,000.

BELLE FOURCHE, S. D.—The Belle Fourche Electric Light, Heat and Power Company will string a line from the Redwater plant of the Black Hills Traction Company to furnish electric light for the town.

ALVIN, TEX.—At a meeting of the City Council a twenty-five year franchise was granted to E. B. Hill for establishing an electric-light plant for the city. The conditions are that he complete it in twelve months.

JOPLIN, MO.—Henry L. Doherty & Co. have purchased the Consolidated Light, Power and Ice Company, of Joplin, and the Galena Light and Power Company, of Galena, Kan., and will erect a central power station. P.

WINNIPEG, MAN.—The City Council of Winnipeg will go ahead with the construction of the power plant on the rapids of the Winnipeg River. The contract will be let at once calling for an expenditure of $1,500,000. C.

VILLA GROVE, ILL.—The Villa Grove Electric Company has been incorporated with a capital stock of $15,000, for the purpose of operating electric-light and power plants. The incorporators are V. M. Elmore, C. W. Hagerman and C. B. Kennington.

COLUMBUS, OHIO—Articles of agreement for the consolidation of the Warren Gas Light and the Hyde Electric Companies, both of Warren, have been filed. The new concern will be known as the Hyde Electric and Gas Company, and the capital stock is fixed at $350,000.

SEATTLE, WASH.—An increase from $500,000 to $800,000 in electric-light bonds for the city of Seattle has been recommended by the City Council's finance committee. It will be submitted to popular vote on December 29. The smaller amount had been previously voted.

BOISE, IDAHO—Articles of incorporation of the Slate Creek Electric Light and Power Company have been filed. The company is capitalized at $3,000,000, and will do a general electric-light and power business in Wallace, Idaho, building a plant to operate a big water right in the Slate Creek district.

LINTON, IND.—The City Council of Linton is in the market for the purchase of $15,000 worth of new equipment for the electric-light plant. The proposition to improve the plant was opposed by many citizens who claim that after eight years of municipal electric-light service the plan has proved a failure. S.

GENEVA, N. Y.—The Geneva-Seneca Electric Company has begun the erection of a new power station. The company intends to expend approximately $150,000 in betterments, of which $75,000 will be utilized in the construction and equipment of a new power plant and the balance upon transmission improvements.

LUDINGTON, MICH.—A. P. Carr and E. J. Quirk are promoters of a company to build an immense concrete and pile dam across the Pere Marquette River in Custer township, to use the waterpower for the production of electricity. A power house will be built and three hydraulic turbines, each capable of generating 500 horsepower, installed.

HAGERSTOWN, MD.—Clarence E. Easterday, Orville E. Shifler and H. L. Moser, composing the Antietam Electric Light and Power Company, are constructing a $13,000 electric plant. The company has contracted to furnish light to the municipality of Boonsboro and is now negotiating to light the towns of Sharpsburg and Keedysville.

OGDEN, UTAH—The Chamber of Commerce of Ogden has gone on record as favoring a municipal electric-lighting plant, and urged the immediate action of the Council in utilizing water owned by the city for that purpose. A resolution was adopted requesting the Council to exercise its rights and perform its duty in establishing electric-light rates in Ogden.

FINDLAY, OHIO—Meter rates have been dispensed with for all commercial lighting at Findlay. Prices have also been reduced from ten to eight cents per kilowatt-hour. While the City Council is advertising for bids for lighting the city after the expiration of present contracts, it is thought that under the concessions named a new contract will be made with the present concern. H.

LYNCHBURG, VA.—A modern electric plant for lighting the country residence, barn, and other buildings on the Nelson County estate of Thomas F. Ryan has been put into commission. "Oak Ridge" is one of the finest estates in Virginia, and is one of the few rural homes in the state to be lighted by electricity developed in a private plant. The power plant cost Mr. Ryan $25,000, it is reported.

SANTA FE, N. M.—Incorporation papers have been filed by the El Paso Power and Light Company, with headquarters at Alamogordo, Otero County. The capitalization is $5,000. The incorporators and directors are J. L. Lawson, A. F. Menger and H. J. Stacey of Alamogordo. The company is to use the power from the Penasco River to generate electricity to be carried to El Paso.

LIMA, OHIO—The latest development in the municipal lighting-plant fight at Lima is the filing of an injunction suit by City Solicitor Rogers, who asks that the legislation under which the work is proceeding be declared illegal and the work be stopped until the matter can be determined by the courts. In the meantime the board of public service is going on with the erection of the new plant. H.

BUCYRUS, OHIO—On the first of March the present city-lighting contract expires and an injunction has been granted against the city restraining it from issuing $80,000 bonds, recently authorized by vote of the people, for the purpose of erecting a municipal lighting plant. Eight bids were tendered and as they were about to be opened the injunction was made on the application of T. M. Droleabaugh, a taxpayer. H.

AUGUSTA, GA.—The contract for the construction of a dam which will also serve as a bridge across the Savannah River at Price's Island, twenty miles above Augusta, has been awarded. The work will be commenced in December and will require about one year to complete. The dam, which will cost about $3,500,000, will be thirty feet high and will furnish 15,000 horsepower, which will be transmitted to Augusta to a substation.

SALISBURY, N. C.—It is reported that work will be resumed on the big $10,000,000 water and electric plant at Whitney, on the Yadkin River, thirty miles from Salisbury. Plans are being formulated for raising $2,000,000 for the completion of the plant, which will furnish electric power to a vast area in North Carolina. More than $5,000,000 has already been spent on the plant. Operations ceased on account of a receivership several months ago.

CHARLOTTE, N. C.—The Westinghouse Electric and Manufacturing Company has secured the largest contract for transformers ever made with an electric manufacturing company. This contract, awarded by the Southern Power Company of Charlotte, N. C., calls for transformers aggregating a capacity of 93,000 kilowatts. The apparatus will be used on the transmission line between Charlotte, Greensboro and Greenville, covering an area of 240 miles.

SAN FRANCISCO, CAL.—Another large hydroelectric power project is now in prospect for central California. It has been announced that the extensive water right properties on the American and Cosumnes rivers, owned by W. H. Tevis and recently offered to the city for a municipal water supply, are to be developed for the production of electric power. C. N. Beal, who is associated with Mr. Tevis in the project, says engineers are still at work on the matter. The properties have been released from the contract with the Bay Cities Company, and will be developed for power. Mr. Beal also states that a market for the power has been secured in advance.

ALBERTVILLE, ALA.—The Sand Mountain Electric Company, composed of Albertville business men, has been organized and active operations will begin toward the erection and installation of a plant to light the town of Albertville. E. O. McCord is president and general manager of the company, which owns the Short Creek Falls (four miles from town), valuable real estate in Albertville and has a twenty-five-year franchise and contract for lighting Albertville.

BRIDGEWATER, MASS.—The Edison Electric Illuminating Company has purchased the plant of the Bridgewater Electric Company and will soon begin extensive improvements, planning to give the town of Bridgewater twenty-four-hour service. A transmission line will be built from East Bridgewater to Bridgewater. The Edison company plans to install arc and incandescent lights along the streets and to increase the electric-power business in the town.

WINDSOR, ONT.—At the approaching municipal elections in Windsor, ratepayers will probably be asked to vote on a by-law to authorize the expenditure of about $25,000 or $30,000 in order to provide a practically new lighting plant for the city. As an alternative proposition, it is likely that they will be given an opportunity to express themselves on the project of purchasing Niagara power from the Hydroelectric Commission of the Ontario Government under the government scheme.

ANACONDA, MONT.—The Great Falls Water Power and Townsite Company announces it is developing approximately 30,000 horsepower now, and will probably add about 50,000 horsepower in other developments later on. The waterpowers at Great Falls were purchased, it is said, in the firm belief that the time is very near when the railroads operating over the mountains must avail themselves of the cheap power furnished by the waterpowers of the state in moving their trains over the mountain grades.

WALLACE, IDAHO.—The Slate Creek Electric Light and Power Company, which is endeavoring to secure a charter from the city for a period of fifty years, has filed articles of incorporation and is capitalized at $3,000,000. The company is to do a general electric-light and power business, the intention being to build a power house in the Slate Creek district, sixteen miles from Wallace. The incorporators are D. L. Hopkins, Thomas McGowan, George W. Baldwin, Jesse Freeman and William Sites. The City Council is said to be favorably inclined toward the new company.

SAGINAW, MICH.—The Eastern Michigan Power Company is seeking to supply Saginaw and Bay City and adjacent territory with electric current for light and power. This company is developing the Au Sable River from Au Sable to Milo, a distance of about 100 miles. The total amount of power that can be developed is declared to be approximately 50,000 horsepower, and this is to be obtained by the erection of ten or twelve dams, ranging in height from twenty-five to forty feet, located at different points along the river, according to the fall and local conditions. The total outlay for the completion of the work will be several millions of dollars. If the franchises are granted the company expects to deliver current in these markets within a year to eighteen months.

TACOMA, WASH.—A report of a civil engineer, H. A. Whitney, on his investigation of the power site offered by Henry Bucey on the west side of Hood canal, shows the inadvisability of utilizing the water from the Dosewallips and Dickabuch rivers for power purposes by means of a dam placed at the foot of a canyon. "The minimum head which the dam will give, if placed where proposed, is 200 feet," says the report. "The flow of the Dosewallips River is 214 cubic feet per second, and of the Dickabuch 114 feet per second. If the city could utilize the rivers to their capacity, it would require an available head of 320 feet in each stream to get sufficient power at this time of the year. It is not possible at the present stage of the water to develop 10,000 horsepower, as proposed by the city council. About 4,000 horsepower is all that could be secured."

ELECTRIC RAILWAYS.

EAU CLAIRE, WIS.—There is a project on foot for connecting Eau Claire and Osseo by an electric railway twenty miles long.

WEBSTER CITY, IOWA—An interurban road between Webster City and Clarion, Iowa, is projected. It is expected that the $300,000 necessary to construct the road can be raised without resorting to bonding the property. C.

DES MOINES, IOWA—The company bonding the Des Moines & Sioux City Electric Railway Company insists that the road be an air line between Des Moines and Sioux City, and it be built to carry 100-ton electric freight locomotives. C.

NASHVILLE, IND.—Joseph Irwin, of the Indianapolis, Columbus & Southern, is making plans to build an electric line from Columbus to Bloomington, via Nashville. Inquiries have been made in regard to franchises and right-of-way. S.

BALTIMORE, MD.—Construction work is nearly completed on the new Baltimore, Halethorpe & Elkridge Electric Railway. The road, which is three and a half miles long, runs from the terminus of the Wilkens Avenue line of the United Railways to Halethorpe.

WARSAW, IND.—Representatives of the Murdock traction system have entered into an arrangement with officials of the Winona Interurban Railway and the Northern Indiana Railway, providing for running cars from Indianapolis to South Bend. The service will be put into effect as soon as the gap between Warsaw and Peru is closed. S.

CRAWFORDSVILLE, IND.—Citizens of Crawfordsville who are interested, announce that the Kokomo, Frankfort & Terre Haute Traction line will be built during the next year, and work will begin on the road at two or more places along the route. The company has placed the bonds on sale and there is every indication that these will find a ready sale. S.

RALEIGH, N. C.—The Burgrahaw Interurban Company, organized with a capital stock of $500,000, proposes building and operating an electric railway between Burlington, Graham, Haw River and other points near Burlington. The incorporators are: C. E. W. Tenney, of New York; F. S. Jones, of Nashville, Tenn., and E. S. W. Dameron, of Burlington.

OTTUMWA, IOWA—The leading business men of Ottumwa and representatives from nearby towns, which are anxious to get interurban roads, attended a meeting of the Ottumwa Commercial Association when the matter was discussed with H. W. Garner, manager of the Oskaloosa Traction and Light Company and the Oskaloosa & Buxton Interurban Company. C.

CAIRO, ILL.—The Cairo City Council has granted a fifty-year interurban franchise and a twenty-year street railway franchise to the McKinley syndicate. The syndicate has already bought the local electric street railway, electric-light plant and the Cairo City Gas Company. An interurban line will be built to connect Cairo with Mounds, Mound City and Villa Ridge, and will later go on to St. Louis.

BELLINGHAM, WASH.—To supply power for the proposed Skagit Interurban Railway, the Stone & Webster interests will double the capacity of the Nooksack power plant. The improvement will cost $250,000, a sum equal to the cost of the plant, which was completed two years ago. When the survey for the interurban right-of-way was made, all streams in Skagit County were carefully examined, but suitable waterpower was not found.

BELOIT, WIS.—Following the "tag-day" movement the City Federation of Women's Clubs of Beloit, Wis., ran the city street cars Saturday, November 21, and the fares collected were added to the fund from the tags to swell the total for the school children of Beloit. The Traction Company made the women the offer, which was promptly accepted, and everyone who patronized the cars—and everyone did—paid fares to the women of the federation, while the regular conductor stood by, attending to stopping and starting the cars. The traction company received no returns from the day's operation except the grateful appreciation of the citizens.

LAFAYETTE, IND.—It is announced that the Fort Wayne & Wabash Valley Traction Company will, during the next year, extend its line from Lafayette to Danville, Ill., where it will make connection with the McKinley Traction System, reaching many towns and cities in Illinois and including St. Louis, Mo. The new extension when built will touch West Point, Attica, Covington, Williamsport and other small towns in a territory thickly settled. S.

BOSTON, MASS.—The Railroad Commission has approved the terms of consolidation of the Middlesex & Boston, the Westboro & Hopkinton and the Natick & Cochituate Street Railway Companies, as the Middlesex & Boston Street Railway Company. The commission also approved an increase in stock of the Middlesex & Boston company to not exceeding $140,000 for carrying out the consolidation and in exchange share for share of the companies above named.

JOLIET, ILL.—The Secretary of State has issued a license to incorporate to the Chicago, Joliet & Western Interurban Railway Company. The principal office is Chicago and the capital stock is nominally $10,000. It is proposed to construct a railroad from the city of Chicago southwest through the counties of Cook, Dupage and Will to Joliet, and west to the counties of Kendall, Grundy and La Salle. The incorporators and first board of directors are headed by G. Fox, of Chicago.

STOCKTON, CAL.—A large meeting of land owners and business men from both Stanislaus and San Joaquin counties has been held at Escalon to further the immediate construction of an electric railway to run adjacent to the French Camp road to Escalon, thence to Modesto, with a main line to Oakdale. J. L. Craig, chairman of the meeting, delivered a convincing address covering the desirability, as well as the necessity to the future welfare of the district, of the construction of the railway.

DENVER, COLO.—Articles of incorporation for the Crags and Canon Railway Company have been filed by George F. Keller, recently of Fort Wayne, Ind., representing capitalists of that city; L. B. Bradley, recently of Chicago; G. A. Brink, D. C. Nevin and N. S. Williams, of this city. The company is capitalized at $300,000 and is incorporated to build a standard-gauge railway from the town of Crags on the Moffat Road to Eldorado Springs, thence to Boulder. Mr. Bradley, who is an electrical engineer, has been in Colorado for the past year, devoting most of his time to surveys of the proposed railway. The final survey from Crags to Eldorado Springs, with a maximum grade of four per cent, has been established and the line from Eldorado Springs to Boulder will not exceed a maximum of one per cent. The plan of the incorporators is to build to Eldorado Springs, if possible, in time for the tourist travel of next season, and when the line is completed to Boulder, it will connect all northern Colorado with the Moffat Road, making a cut-off that will save about sixty miles of travel by way of Denver to reach western points on the Denver & Northwestern Pacific.

OBITUARY.

MR. JAMES E. MURDOCK, head of what is known as the Murdock syndicate of interurban lines in northern Indiana, and one of the wealthiest men in the state, dropped dead in his home in Lafayette, Ind., November 27, at the age of seventy-one years. Mr. Murdock had been a prominent figure in the construction of the lines of the South Bend & Chicago and of the Fort Wayne & Wabash Valley Traction companies, and was president of the Merchants' National Bank of Lafayette at the time of his death, besides retaining his earlier connections with the natural-gas industry in Ohio and Indiana. Mr. Murdock was born in Ireland in 1837, coming to Lafayette when a lad. He started the career which led to his great fortune, by working in a brick yard. Mr. Murdock was not only enterprising in the building up of the great systems of which he was the nominal head, but was also known to be benevolent, never refusing, it is said, to contribute to a worthy cause. S.

ENGINEERING SOCIETIES.

INDIANA ACADEMY OF SCIENCE—The Indiana Academy of Science held its annual session at Purdue University, Lafayette, Ind., beginning November 27. "Deforestation and Its Effects" was the subject of the official address of Prof. Glen Culbertson of Hanover College, president of the body. Following a general inspection of the departments of Purdue University, the evening session was held in the lecture room of the electrical building, where a large audience heard an illustrated lecture and demonstration by Prof. H. T. Plumb, associate professor of electrical engineering at Purdue, on "High-Frequency Currents."

S.

ITHACA SECTION, A. I. E. E.—The second regular meeting of the Ithaca Section, American Institute of Electrical Engineers was held November 19, with 130 members and visitors present. Prof. H. H. Norris gave an experimental demonstration of "Atmospheric Insulator Losses in Transmission Lines." Various corona effects were shown, and by means of wattmeter measurements the corresponding power losses were determined. The sixty-thousand-volt transformer used in these experiments was the one designed and constructed by Prof. H. J. Ryan, and used in his famous experiments. This demonstration was appropriate in view of the recent discussion of Mr. Mershon's Atlantic City paper before the local section. Where such experiments are practicable in the section meetings they go far to arouse interest in the Institute papers.

FORT WAYNE SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—The Fort Wayne Section of the American Institute of Electrical Engineers held a well-attended meeting on November 12, which was preceded by the usual informal dinner. The paper for the evening, "Paralleling of Alternators," presented by J. J. Kline, of the Fort Wayne Electric Works, was followed by a very active discussion, in which many interesting things were brought up. A. L. Hadley spoke at some length on the cross currents which occur in alternators direct-connected to slow-speed gas engines and the difficulty of adjusting the prime movers so as to reduce the cross currents to a minimum. M. J. Kehoe described his experience with some steam turbines direct-connected to alternators, citing a case which had occurred in his plant on frequent occasions, when with two machines running in parallel without apparent cause the machines would suddenly drop their load and the voltage would fall to zero. There seemed to all intents and purposes to be no cause for this on the part of the alternators, but it had occurred on numerous occasions and the makers failed to furnish a suitable explanation of the difficulty. It was suggested that the cross currents and armature reaction might succeed in demagnetizing the poles due to an excessive overload. Mr. Kehoe was asked to furnish further information on this point at the next meeting, although, as he explained, the trouble had been entirely obviated by the adoption of a Tirrill regulator. Owing to the lateness of the hour further discussion was postponed until next meeting. At the next regular meeting E. A. Barnes, superintendent of the Fort Wayne Electric Works, will present a paper, "Choice of Power for Industrial Purposes."

ELECTRICAL SECURITIES.

The general undertone of last week's stock market was firm, although there was considerable irregularity. Some smart rallies were shown, as compared with a week ago, and while trading was less active than previously and largely professional, there was some gain in this direction. The increased buying, however, did little to attract further public participation, and there has been quite a slump in commission business. It is understood that the larger interests are favoring higher prices. There has been no change in the bank situation, except that money rates have worked lower, especially for time funds, with liberal offerings. The indications are that if there is any turn, it will be for an easier market.

Dividends have been declared upon the following electrical securities: Regular semi-annual dividend of $4 per share on the capital stock of the Electric Light and Power Company, of Abington and Rockland, payable January 1 to stock of record December 21. Massachusetts Electric Companies' trustees have voted to resume the dividends on the $20,557,400 preferred stock by a declaration of a dividend of one per cent. The last regular semi-annual dividend on the preferred was paid January 1, 1905. Puget Sound Electric Railway; semi-annual dividend of $3 on the preferred stock, payable January 1 to stock of record December 15. Consolidated Gas Company, of New York; quarterly dividend of one per cent, payable December 15. Chicago Telephone Company; quarterly dividend of two per cent, payable December 31 to holders of record December 23. Mackay Companies; quarterly dividends of one cent on the common and preferred stocks, payable January 2 to holders of record December 12. Michigan State Telephone Company; quarterly dividends of one per cent on the common, payable December 1, and one-and-one-half per cent on the preferred stock, payable February 1.

ELECTRICAL SECURITIES FOR THE WEEK ENDED NOVEMBER 28.

New York:	*Closing.*
Allis-Chalmers common	14⅝
Allis-Chalmers preferred	48½
Brooklyn Rapid Transit	55¼
Consolidated Gas	162½
General Electric	158¾
Interborough-Metropolitan common	14½
Interborough-Metropolitan preferred	35⅛
Kings County Electric	128
Mackay Companies (Postal Telegraph and Cables) common	75¾
Mackay Companies (Postal Telegraph and Cables) preferred	71
Manhattan Elevated	146¼
Metropolitan Street Railway	30
New York & New Jersey Telephone	121
Western Union	71½
Westinghouse Manufacturing Company	91¼

Application has been made to the New York Stock Exchange by the Interborough Rapid Transit Company to list $25,000,000 three-year convertible six per cent notes.

The Consolidated Gas Company announces that more than $13,000,000 of the $20,000,000 outstanding six per cent convertible bonds have been turned in and exchanged for stock.

Current earnings of the Western Union Telegraph Company are reported by official sources as steadily improving, and the figures for the quarter ending December 30 are expected to considerably exceed the last two quarters and the normal earnings of the same period prior to the year 1907. The increase in gross revenue has been seconded by economies in operation and maintenance and has produced a large increase in net.

The New York & New Jersey Telephone Company will offer to stockholders $5,047,000 new stock in the ratio of one share of new for each five of old. The right to subscribe expires January 16, 1909, on which date a payment of fifty per cent must be made. The other fifty per cent is divided into two equal payments on April 6 and July 16, 1909. Right to subscribe accrues to stock of record December 1.

Boston:	*Closing.*
American Telephone and Telegraph	130¾
Edison Electric Illuminating	250
Massachusetts Electric	60
New England Telephone	124½
Western Telephone and Telegraph pref.	75
Philadelphia:	*Closing.*
Electric Company of America	10½
Electric Storage Battery common	43
Electric Storage Battery preferred	43
Philadelphia Electric	11½
Philadelphia Rapid Transit	22⅞
United Gas Improvement	93⅞

November earnings of the Philadelphia Rapid Transit Company, while not as good as those of October, which showed $85,000 increase in gross over last October, are very satisfactory, and will show a large increase over November, 1907. No action has been taken in regard to a new director to succeed George H. Earle.

Chicago:	*Closing.*
Chicago Telephone	129
Commonwealth Edison	104¾
Metropolitan Elevated preferred	42
National Carbon common	80
National Carbon preferred	112

It is announced that Chicago Telephone bonds to the amount of $1,000,000 will be offered to the public.

INDUSTRIAL ITEMS.

THE CAMPBELL-STAGG COMPANY, New York, calls attention by a useful blotter to its "Star" bushings for conduit, which are obtainable at all supply houses.

THE WARNER ARC LAMP COMPANY is erecting a factory at Wilton, Iowa, which when completed will provide employment for more than one hundred men. The plant will have a capacity of 125 finished lamps per day.

WICKES BROTHERS, Saginaw, Mich., machinery manufacturers and dealers, have issued their monthly stock list, dated November 15, listing boilers, engines, dynamos, motors and machinery in stock at their sales warehouses at Saginaw, Pittsburg, New York and Jersey City.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, manufacturer of automatic telephone apparatus, directed the attention of visitors to the Independent Telephone Convention, held at the Auditorium Hotel, Chicago, this week, to its exhibit in Rooms 614 and 616, where some of its latest automatic products were shown.

L'ARGUS DE LA PRESSE, Paris, whose offices were destroyed by fire January 15, announces that it has been completely reorganized and that its documents, collections and special services have been re-established and improved. The new address of the publication is Faubourg Montmartre, 37 Rue Bergere, Paris.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, 184 Lake Street, Chicago, is making a specialty of the "Wizard" massage vibrator. The vibrator weighs one and one-fourth pounds, and operates on both alternating and direct current. It is supplied with an aluminum case, maple handle, green silk conductor cord, scalp, face and body applicators and a small leatherette-covered case.

THE DURANT ELECTRIC SUPPLIES COMPANY, 60 Fifth Avenue, Chicago, will send prices and samples of Ironite duplex drop wire upon application. Ironite is declared to be flexible and as easily handled as soft-drawn copper. It will not sag or stretch, and linemen can pull all the slack out of the line without fear of breaking the conductor.

THE HOLOPHANE COMPANY, New York city, in the November issue of *Holophane Illumination* gives considerable attention to the subject of good lighting in factories. A couple of interesting illustrations are shown of the use of the Holophane-D'Olier metal reflectors, throwing the light just where the workman needs it, and eliminating errors due to bad lighting.

THE GENERAL ELECTRIC COMPANY'S incandescent lamp works at Fort Wayne, Ind., will increase its output fifty per cent, which will mean 130,000 lamps a week. Superintendent H. K. Jones recently returned from a meeting of superintendents held at Harrison, N. J., with instructions to increase the output of the Fort Wayne plant. This will require some additional facilities as well as an increased force of men.

THE GRANT FLAMING LAMP COMPANY, 239 Railway Exchange Building, Chicago, district agent for the Grant flaming-arc lamp manufactured by the German-American Electric Company, New York city, has issued a descriptive folder and price list of lamps and carbons. The Grant lamp is manufactured in two standard types burning ten and seventeen hours, respectively, and its design is believed to present several advantages in operation and efficiency.

THE WESTERN ELECTRIC COMPANY, New York and Chicago, tells in booklet form what it is doing to increase the central-station load. In the past year of depression the company has prosecuted a sales campaign for electrical apparatus and supplies more vigorously than ever before and has met with a gratifying response. A large and important factor of this sales campaign has been advertising in the technical press, trade papers and popular magazines, advocating electric motor drive and electric illumination. The company's business has already been largely stimulated, and in consequence of the greater use of apparatus and supplies, the business of the central station has been correspondingly increased. The pages of the booklet are taken up with some illustrations of Western Electric advertisements that have appeared.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., is distributing the initial number of *Motor Talks*, a monthly house organ whose December issue is seasonably concerned "chiefly about Christmas." The company has prepared a suitable box, covered with holly paper and tied with red ribbon, to contain the electric motors for driving sewing machines and mechanical washing outfits, which it recommends as useful and appreciated gifts.

THE NERNST LAMP COMPANY, Pittsburg, Pa., announces that an order has been received for three-glower lamps to replace the six-glower Nernst lamps in the corridors of the Frick Building, Pittsburg. Nernst lamps have been used in this building for the last five years, and the new lamps will give the same amount of light as the old at a saving of twenty-five per cent in the current consumption. They have the added advantage of simplified renewal at a material reduction in cost.

THE CENTRAL ELECTRIC COMPANY, Chicago, is distributing a fifteen-page circular describing "O. K." fuse-block covers and meter-connection blocks. Thirty-six diagrams illustrate the methods of connecting and testing house meters without interruption to the service. The booklet is entitled "Theft of Current," and it is believed that the use of these connection blocks will effect a very considerable decrease in unaccounted-for current at central stations. A copy of this booklet will be sent upon request.

THE INTERNATIONAL ACHESON GRAPHITE COMPANY, Niagara Falls, N. Y., responding to a very general demand for Acheson graphite, grade 1340, combined with grease, for lubricating purposes, is now supplying several combination lubricants of unusual merit. The purity and smoothness of this product have won for it the highest appreciation as a lubricant. All who have used it are believed to realize that it is free from the impurities of natural graphites, finding this electric furnace product of great benefit in general lubrication.

JAMES BIGGS & COMPANY, 109 Liberty Street, New York city, announce that the Blackburn-Smith feed-water filter and grease extractor has been chosen for the new colliers—Mars, Hector and Vulcan—now being built for the United States Navy by the Maryland Steel Company. The filters are to be placed in the feed lines, securing the double filtration characteristic of the Blackburn-Smith apparatus. These filters are also used for protecting the boilers of stationary plants from floating particles of oil, grease, mud, etc., in the feed water. The manufacturers are distributing an interesting booklet on the subject of feed-water filtration.

THE DIEHL MANUFACTURING COMPANY, Elizabethport, N. J., devotes bulletin No. 56 to direct-current motors for driving sewing machines. The motor is so arranged that pressure on the treadle operates a lever which closes the switch and starts the motor. Further pressure engages the friction wheels of the transmitter and the degree of pressure regulates the friction between the wheels so that by varying the pressure on the treadle any desired speed may be obtained from a single stitch to the full speed of the machine. When the treadle is released a spring attached to the lever disengages the friction wheels, opens the switch and applies the brake.

THE GENERAL INCANDESCENT LAMP COMPANY, Cleveland, Ohio, has moved its general office from the factory at 1811 East Forty-fifth Street to Suite 202-208 Electric Building, Cleveland. Larger quarters were necessary, the company announces, in order to handle the greatly increased volume of business which it has secured since the introduction of the G. I. tungsten lamp. The General Incandescent Lamp Company is one of the oldest of its kind in the United States. It manufactures a full line of carbon, Gem and high-efficiency lamps, including miniature and low-voltage, both tantalum and tungsten lamps, for all voltages and conditions. It also has a special department where any special type of lamp can be promptly manufactured, and solicits this class of business.

THE PETTINGELL-ANDREWS COMPANY, Boston, Mass., dealers in electrical merchandise, is anticipating the holiday season in mailing copies of a handsome little descriptive booklet on Empire miniature lamps. These specialties are particularly useful for decorative purposes at Christmas time or for hotels, public buildings or house decoration at any season of the year. The lamps catalogued include almost every conceivable shape and style of globe and are made in a variety of colors and frostings. Some popular shapes include those designated as twist-flame, festoon, torpedo, candle, limousine and dome, besides a number of special lamps for surgical, instrument and other uses.

THE BOSTON INCANDESCENT LAMP COMPANY, Danvers, Mass., announces that in its page advertisement which appeared in the issue of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for November 21, an error was made in stating that the lamps mentioned were made in candlepowers from four to fifteen. The company is anxious to have this error corrected, because the majority of the lamps sold are of sixteen candlepower, and at the reduced price at which the lamps are marketed the assumption might be made that only four to fifteen candlepower lamps were advertised, not including sixteen-candlepower lamps. The copy furnished by the Boston Incandescent Lamp Company read "four to sixteen candlepower," and the advertisement as it appeared was incorrect because of a typographical error.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., is equipping the large textile mill of the Windham Manufacturing Company with electric drive. A complete electric power plant, including motors, transformers and switchboards, has just been shipped to the mills at Willimantic, Conn. The equipment consists of nine 550-volt squirrel-cage induction motors aggregating about 500 horsepower, which will be used to drive the machinery in the mill. The generating equipment consists of two 500-kilovolt-ampere generators. Sixty-cycle, three-phase current will be generated at 600 volts and transformed to 110 volts for lighting. The motors are all arranged for ceiling suspension. The transformers for the lighting system and the switchboard were also furnished by the Crocker-Wheeler Company.

THE BUREAU OF ILLUMINATING ENGINEERING, 437 Fifth Avenue, New York city, announces that it is prepared to carry out the work usually alloted to the illuminating engineering of commercial departments of central stations where the amount or character of the work will not permit the company's own engineers to undertake it, and the Bureau will also act as consulting engineer for companies maintaining these departments where advanced information is desirable. Unique contracts are being made in these connections, permitting a central-station company to submit a stipulated number of lighting problems over a stated period of time. In addition to engineering duties, the Bureau designs globes and reflectors, lighting fixtures, and outline, display and decorative lighting effects. Photometric and illuminometer tests are also made, and the Bureau oversees acceptance and performance tests on all characters of artificial illuminants and accessories. Major E. L. Zalinski, U. S. A. (retired), is president of the Bureau, and Albert J. Marshall, chief engineer.

PUBLICATIONS.

THE ELECTRICAL INDUSTRY OF PERU—Vol. II of the descriptive treatise on the electrical industry of Peru, by Emile Guarini, has been published. This covers the possibilities of electrical development in that country and the electrical service established at Lima and its environs. The price of the publication, which is in Spanish, is three sols, and it may be had from the Electrical Section de la Escuela Nacional de Artes y Oficios, Lima, Peru.

UNITED STATES PATENT OFFICE GAZETTE—Commencing with Volume 138, January, 1909, the Official Gazette of the United States Patent Office will be published in monthly instead of bi-monthly volumes. The yearly subscription price, $5, will remain unchanged, but the price of single volumes, unbound, will be fifty cents. Indexes, digests, and title pages for each volume will be furnished regular subscribers and purchasers of unbound volumes. The price of bound volumes will be $2.50.

WIRE INSPECTION BUREAU HANDBOOK—The Wire Inspection Bureau Handbook for November, 1908, issued by the Wire Inspection Bureau, 29 West Thirty-ninth Street, New York city, describes manufacturers' tests for rubber-covered wire and flexible cord. A list of the companies employing the Wire Inspection Bureau to make, supervise and verify tests on wire and flexible cord is given, with a sample of the Bureau's stamp, the presence of which indicates that the wire has successfully withstood the test prescribed.

NEW MANUFACTURING COMPANIES.

MINNEAPOLIS, MINN.—The Minneapolis Electric Motor Company has been incorporated with a capital stock of $50,000, to manufacture and deal in electrical supplies, machinery and fixtures. Walter H. Vilett, John W. Helm and John M. Zeessman are the incorporators.

ALBANY, N. Y.—A certificate of incorporation of the Bell Arc Light Company of Brooklyn has been filed with the secretary of state. The capital is $100,000, and the directors are Charles A. Campbell and Henry W. Van Alen of Brooklyn, and Monroe May of New York city.

NEW YORK, N. Y.—The Tesla Electrotherapeutic Company, of New York, has been incorporated to manufacture and deal in electro-hygienic and electrotherapeutic apparatus. Its capital is $400,000 and the incorporators are: Archibald M. Langford, Morton G. Bogue and Ward W. Pickard, all of New York.

DATES AHEAD.

American Roentgen Ray Society. Annual meeting, New York city, December 28-30.

Chicago Electrical Show. Coliseum, Chicago, Ill., January 16-30, 1909.

American Association for the Advancement of Science. Annual meeting, Baltimore, Md., January, 1909.

Northwestern Electrical Association. Annual meeting, Milwaukee, Wis., January, 1909.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) November 24, 1908.

904,522. CABLE CONNECTOR. John D. Firmin, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed August 20, 1906. A coupler has two threaded counterpart terminal members with threaded interfitting projections and clamping sleeve screwed over the extensions.

904,524. ELECERIC-LIGHTING DEVICE. Joshua T. Fisk, Rochester, N. Y., assignor to Metal Specialties Manufacturing Company, Chicago, Ill. Filed October 28, 1907. An electrical cigar lighter is provided with a receptacle and a convolute resistance wire mounted in the same.

904,525 and 904,526. OVERHEAD ELECTRIC RAILWAY. Francis M. Frederick, St. Louis, Mo., assignor to Francis T. Moormann, Charles H. Poth, Thomas B. Poth and Frank J. Vollmer, St. Louis, Mo. Filed November 4, 1907. Comprises an elevated track rail, a motor-driven truck operating thereon, a car suspended from the truck and compressed-air means carried by the car for raising or lowering it.

904,529. ELECTRIC FURNACE MUFFLE. John F. Hammond, Prince Bay, N. Y., and Ralph B. Savin, Philadelphia, Pa., assignors to the S. S. White Dental Manufacturing Company, Philadelphia, Pa. Filed February 27, 1908. Consists of a hollow electrically wired inner member, a hollow outer member and a plug fitting in the rear end of the latter.

904,532. ARC-LAMP ELECTRODE. Henry S. Hatfield and Frank M. Lewis, Brighton, England. Filed July 31, 1908. Composed of some eight parts of calcium fluoride, five parts of carborundum, and carbon.

904,540. PROCESS OF ELECTRIC WELDING. Laurence S. Lachman, New York, N. Y., assignor to Standard Pulley Manufacturing Company. Filed March 24, 1905. A process for uniting metal sheets by a number of autogenous spot welds at projections integral with the sheets.

904,541. DEVICE TO PREVENT TROLLEY WHEELS FROM JUMPING. William O. Lane, Cleveland, Ohio. Filed March 12, 1908. A pair of spaced guide arms is arranged to be connected to the pole and held in advance thereof.

904,550. AUTOMATIC FIRE-ALARM, BURGLAR-ALARM AND TELEPHONE SYSTEM. George F. Milliken, Boston, and Frederick W. Cole, Newton, Mass., assignors to Gamewell Fire-Alarm Telegraph Company, New York, N. Y. Filed October 16, 1905. A normally closed circuit connects the central station with subscribers' stations provided with telephone equipment and alarm-transmitting devices.

904,583. TELEPHONE SYSTEM. Harry G. Webster, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed February 28, 1903. Relates to a supervisory relay associated with the cord circuit.

904,592. ELECTRICAL CONDUCTOR SUPPORT. John S. Allen, Los Angeles, Cal. Filed March 22, 1906. A double petticoat insulator is suspended from a cross-arm and carries the conductor beneath it.

904,603. CONNECTOR. Clarence T. Crocker, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Filed August 31, 1906. A coupler for cables comprises terminal members having interfitting extensions and a pair of sleeves for clamping them together.

904,609. ELECTRIC INCANDESCENT LAMP. Frederic W. Erickson, New York, N. Y. Filed January 28, 1908. A light diffuser consists of a lamp having a plain globe, a casing about the same made of two interlocking parts, one a reflector and the other of colored glass.

904,616. STARTING MECHANISM FOR INTERNAL-COMBUSTION ENGINES. Henry C. L. Holden, Blackheath, and George K. B. Elphinstone, Lewisham, England. Filed October 28, 1907. Means for insuring that the mechanism used for giving a few turns to the crankshaft can only be brought into action when the sparking circuit is broken.

904,624 and 904,625. DEVICE FOR REVERSING THE DIRECTION OF ROTATION OF INTERNAL-COMBUSTION ENGINES. Leon Le Pontois, New Rochelle, N. Y. Filed August 2, 1907. An electrical ignition governor has an ignition circuit, one of whose electrodes is operated by an air-pump piston.

904,632. VIBRATORY APPARATUS FOR EAR TREATMENT. Eugene Meyer, New York, N. Y. Filed February 2, 1908. A vibratory hammer lever is provided with an armature actuated by an electromagnet.

904,640. ARC LAMP FOR STEREOPTICONS, ETC. Herbert F. Patton, Cleveland, Ohio. Filed May 13, 1907. Comprises means adapted to support two carbons at right angles.

904,645. BATTERY GRID. Franklin W. Post and Archie M. Morley, Los Angeles, Cal. Filed August 21, 1906. A storage-battery grid has opposite sets of spaced ribs disposed in parallel planes.

904,661. CIRCUIT-CLOSING RELAY. Jean F. Webb, Jr., Denver, Colo., assignor to the Electric Signagraph and Semaphore Company, New York, N. Y. Filed May 12, 1908. Two supporting frames for the magnets and armature respectively are arranged to be connected to a local circuit.

904,663. MANUFACTURE OF RAIL BONDS. Walter H. Williams, Mansfield, Ohio. Filed November 14, 1906. A stranded terminal member is made by separating the strands to form an aperture, then inserting one end into this and compressing the whole into a solid mass.

904,677. ELECTRIC-CURRENT BATHING TUB. Friedrich Braun, Dresden, Germany. Filed December 4, 1907. This tub has electrodes at its ends and an insulating partition across the tub and adapted to support the knees of the bather with the feet in one compartment and the body in another.

904,684. METHOD OF ELIMINATING COPPER FROM COAGULATED CELLULOSE. Emile Crumière, Paris, France. Filed February 19, 1908. Consists in passing a current through a solvent in which the cellulose is immersed so as to dissolve the copper and deposit it on a cathode.

904,693. SYNCHRONOUS SPEED INDICATOR. Arthur E. Griffin, Winthrop, Mass., assignor to Sears B. Condit, Jr., Boston, Mass. Filed March 13, 1905. An induction motor has a make-and-break device mounted thereon and operated by its rotor, and an indicator energized by alternating current and by induced current from the make-and-break device.

904,728. ELECTRIC-LAMP RECEPTACLE FOR ELECTRIC SIGNS. Frederick W. Ruby, Jackson, Mich. Filed March 20, 1908. The front edge of the socket is supported flush with the sign surface by two sleeves threaded over the socket.

904,741. ELECTRICALLY OPERATED SEMAPHORE MECHANISM. Jean F. Webb, Jr., Denver, Colo., assignor to the Electric Signagraph and Semaphore Company, New York, N. Y. Filed May 12, 1908. A motor drives a gear carried by the semaphore shaft.

904,743. ELECTRICAL PRINTING APPARATUS. Milton T. Weston, Orange, N. J. Filed September 25, 1901. Contains a number of electromagnetically controlled trip devices.

904,765. SYSTEM OF CONTROL FOR ELECTRIC MOTORS. Arthur C. Eastwood, Cleveland, Ohio. Filed May 9, 1908. There is a manually controlled resistance in series with the main motor circuit and a second resistance automatically cut out when the current in the motor is below a certain value.

904,768. TELEGRAPH SYSTEM. Stephen D. Field, Stockbridge, Mass. Filed December 1, 1906. An electromotive force counter to that of the line current is impressed on the line at the instant when the circuit is open to form the signals.

904,771. ELECTRIC WELDING MACHINE. Weston M. Fulton, Knoxville, Tenn., assignor to the Fulton Company, Knoxville, Tenn. Filed February 7, 1906. Consists of a number of yieldingly pressed rotatable electrodes for welding lapped seams.

904,776. SYSTEM OF ELECTRIC DISTRIBUTION. Caryl D. Haskins, Schenectady, N. Y., assignor to General Electric Company. Filed September 26, 1904. The rotor of a motor meter controls an electromagnet for periodically opening and closing the line switch.

904,780. SYSTEM OF CONTROL. George H. Hill, Schenectady, N. Y., assignor to General Electric Company. Filed March 23, 1907. Comprises a controller for alternating-current operation, a controller for direct-current operation and a master controller for governing both the controllers.

904,782. ROTARY CONVERTER FOR ELECTRIC WELDING. Arthur M. Hoffman, Johnstown, Pa. Filed December 23, 1907. A device for converting direct into alternating current consists of a commutating and resistance-controlling rotor.

904,783. INDICATING AND RECORDING INSTRUMENT. William F. Howe, Schenectady, N. Y., assignor to General Electric Company. Filed September 17, 1907. A motor meter has current and potential coils, a disk armature for the coils, a damping magnet and a pivoted sheet-metal indicating armature mounted in the field of the coils and of the magnet.

904,786. CIRCUIT CLOSER FOR FIRE-ALARM CIRCUITS. William W. Katterjohn, Henderson, Ky. Filed May 20, 1908. A spring connected to the circuit closer and adapted to close the same upon retraction is held in extended position by two series of oppositely placed eyes and cords.

904,788 and 904,789. AUTOMATIC CARRIER SYSTEM. Sam H. Libby, East Orange, N. J., assignor to Sprague Electric Company. Filed March 12, 1906. An electrically operated traveling carrier system is automatically controlled from the loading stations to the unloading stations.

904,794. GENERATION, CONTROL AND TRANSMISSION OF ELECTRIC ENERGY, PARTICULARLY FOR USE ON AUTOMOBILES AND LIKE VEHICLES. Albert H. Midgley, London, England. Filed February 26, 1908. The engine drives a dynamo having two armatures, one of which supplies current to the propelling motor.

904,801. CURRENT-COLLECTING APPARATUS FOR DYNAMO-ELECTRIC MACHINES. Jakob E. Noeggerath, Schenectady, N. Y., assignor to General Electric Company. Filed October 10, 1906. A laminated brush is pressed against the collector by a U-shaped spring on the brush holder.

904,808. INSULATING MATERIAL. George H. Rupley, Schenectady, N. Y., assignor to General Electric Company. Filed August 7, 1907. Is made from a fabric impregnated with a soft, pliable, non-adhesive material and coated with linseed-oil varnish.

904,810. DISTANCE CONTROL APPARATUS FOR TRANSLATING DEVICES. Ernest Schattner, London, England, assignor to General Electric Company. Filed August 6, 1906. A multiple-rate meter connected to a supply circuit has means responsive to currents of different frequency and arranged to set the meter to register at corresponding rates.

904,821. SHADE HOLDER FOR INCANDESCENT ELECTRIC LAMPS. John Weber, Schenectady, N. Y., assignor to August Weber, Sr., Schenectady, N. Y. Filed July 21, 1905. Is provided with telescopically engaging members adapted to interlock automatically with a snap action.

904,826. LAMP REDUCER. Charles Wirt, Philadelphia, Pa., assignor to Charles Wirt and Company, Newark, N. J. Filed March 18, 1907. A turn-down lamp socket has a rotary rheostat ring surrounding it.

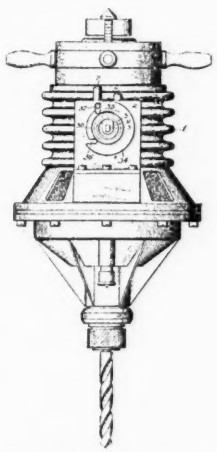
904,831. PROCESS OF MAKING HOMOGENEOUS BODIES FROM TANTALUM METAL OR OTHER REFRACTORY METALS. Werner von Bolton, Charlottenburg, Germany, assignor to Siemens & Halske Aktiengesellschaft, Berlin, Germany. Filed January 5, 1904. Consists in uniting the powdered metal into a coherent mass, then heating this to the melting point by means of an electric current.

904,832. ELECTRICAL FUSE PLUG. Harold E. Bradley, Greenwood, R. I., assignor to Marion C. Happoldt, Providence, R. I. Filed January 3, 1908. A cap engages and can be locked to the casing that receives the fuse.

904,834. ELECTRIC RAILWAY SIGNALING SYSTEM. Yorke Burgess, Washington, D. C. Filed December 7, 1907. Line conductors are formed in sections, each having portions in different planes.

904,850. TELEPHONE SYSTEM. Francis W. Dunbar, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed May 9, 1904. Describes a polarized line-signaling device connected to the line at the central office.

904,851. CONTROLLER FOR ELECTRIC DRILLS. William O. Duntley, Chicago, Ill., and Henry J. Kimman, Cleveland, Ohio, assignors to Chicago Pneumatic Tool Company, Chicago, Ill. Filed January 22, 1906. The drill is provided with grasping handles, a main switch arranged adjacent one of them, a reversing switch and a sleeve concentric with the handle for operating the latter switch.



904,851.—CONTROLLER FOR ELECTRIC DRILL.

904,871. ELECTROMAGNET. George W. Henry, New York, N. Y., assignor to Henderson P. Childress and John L. Lequin, New York, N. Y. Filed July 31, 1907. A magnet has an armature and a lever with a rocking fulcrum bearing and pivotal connection with the armature.

904,877. TROLLEY FOR CARS. John Kaufman, Hazleton, Pa., assignor to H. H. Shellenberger, Easton, Pa. Filed June 5, 1908. Mounted on a trolley pole is a two-part head hinged together on a vertical axis and a contact wheel journaled on the outer end of each part.

904,881 and 904,882. PROCESS OF ELECTRIC WELDING. Laurence S. Lachman, New York, N. Y. Filed May 8, 1907. Renewed April 23 and 27, 1908. The process of uniting two bodies of metals by a spot weld consists in providing at least one of the bodies with a perforation, placing them together and passing a current through them in the region surrounding the perforation.

904,887. VOLTAGE REGULATOR FOR DYNAMO-ELECTRIC MACHINES. George S. Neeley, St. Louis, Mo. Filed November 30, 1906. An alternator has an exciter and means for regulating the field resistance of the latter.

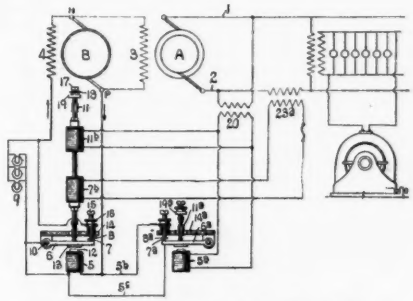
904,889. ALARM DEVICE FOR FIRE-ALARM BOXES. Joshua B. Nicholson and Artemus R. Warfield, Washington, D. C. Filed June 30, 1908. An electric bell adjacent the box is rung when the alarm circuit is closed.

904,890. BRAKE MECHANISM. Frederick H. Osborn, Garrison, N. Y. Filed February 4, 1908. An electrically controlled brake for a phonograph.

904,892. STREAM-POWER ELECTRIC FLOAT. William J. Pattosien, San Rafael, Cal. Filed December 17, 1907. A dynamo, having both field magnets and armature rotatable, is operated by two undershot waterwheels, one for the field magnets and the other for the armature.

904,894. DAMPER REGULATOR. William Roberts and Delford H. Holloway, Waterford, N. Y., assignors to Charles W. Scoville, Cohoes, N. Y. Filed September 11, 1907. An electrically controlled damper-operating device.

904,897. ROTARY SWITCH. Frank J. Russell, New York, N. Y. Filed May 13, 1907. An electric switch is provided with a base having stationary contacts and rotatable switch plug stamped into rectangular form.

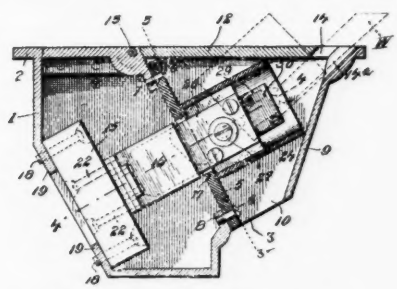


904,887.—VOLTAGE REGULATOR.

904,898. FLOOR-POCKET RECEPTACLE AND PLUG. Frank J. Russell, New York, N. Y. Filed June 7, 1907. A floor box has an inclined shield board which divides the box into separate compartments, a receptacle member in one compartment and a plug member arranged for insertion through the other compartment.

904,902. LINE INTERRUPTER FOR ELECTRIC RAILWAYS. Albert Thode, Hamburg, Germany. Filed July 8, 1908. An insulator has plates attached laterally to it that are adapted to raise a sliding bow from the latter when it passes under the line interrupter.

904,903. TELEPHONE ANNUNCIATOR AND JACK. Henry Tideman, Menominee, Mich. Filed July 6, 1907. A switchboard drop and jack.



904,898.—FLOOR RECEPTACLE.

904,906. DRUM CONTROLLER. Henry J. Wiegand, Milwaukee, Wis., assignor to the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Filed March 14, 1907. Combined with a number of reversing switches and resistance switches is a single drum provided with cams for actuating the switches.

904,917. CONDITION-CONTROLLING DEVICE. James I. Ayer, Cambridge, Mass., assignor to Simplex Electric Heating Company, Boston, Mass. Filed October 29, 1906. A pair of contacts is pivotally mounted in a support and a circuit-closing element is movable so as to engage either contact.

904,918. SIGNALING SYSTEM. Garrison Babcock, Rochester, N. Y., assignor to Merton E. Lewis, Rochester, N. Y. Filed May 31, 1906. An alarm system is equipped with substations consisting of a box, a break-wheel mechanism and telephone apparatus within the box.

904,925. SYSTEM OF ELECTRICAL DISTRIBUTION. William L. Bliss, New York, N. Y. Filed August 4, 1904. An axle car-lighting system.

904,928. ATTACHMENT FOR SAFETY FUSES. William J. Boemper, Rutherford, N. J., assignor of one-half to Harry A. Muecke, New York, N. Y. Filed October 4, 1907. A safety-fuse clip is provided with two pivotally connected curved arms.

904,936. TELEGRAPH REPEATER. Lewis B. Cecil, Santa Barbara, Cal. Filed February 25, 1908. Consists of a main-line and a branch-line relay.

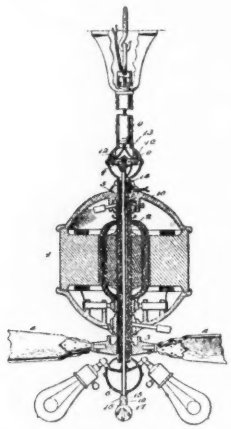
904,945. WIRE BRACKET OR HOLDER AND INSULATOR. Isaac L. Edwards, Aurora, Ill. Filed March 5, 1908. A box made of separable sections united by a joint has an insulator within it formed of separable sections.

904,952. COMBINATION TROLLEY AND TELEGRAPH POLE. James Hackett, Bellaire, Ohio. Filed August 14, 1908. The pole comprises stepped sections, a head carried by the upper one and having extensions for insulators and cable supports.

904,969. LIGHTNING ROD. George R. Kress, Pittsburg, Pa. Filed February 6, 1908. There is in combination a top section, a continuous line rod and a separate Y-shaped joint, connected to the section and rod.

904,971. AUTOMATIC RAILWAY ALARM. Niels Lang, Vancouver, British Columbia, Canada. Filed April 21, 1908. An electric circuit extends throughout the section of track to be protected, one end being connected to the rails and the other to a series of contact plates at intervals along the track.

904,979. HOLDING DEVICE FOR NEWSPAPERS. John K. Morris, Newhall, Cal. Filed May 8, 1908. A pair of jaws works with a rod having a wedge-shaped head on the opposite end and electrical means for ringing a bell when the rod is forced backward by a paper.



905,089.—CEILING FAN.

904,985. EMERGENCY VALVE. Oliver Penn, Pittsburg, Pa. Filed July 1, 1908. A pair of electromagnetic devices operates the valve.

904,991. PROCESS OF SMELTING METALLIC COMPOUNDS AND PRODUCING CARBIDES. Edgar F. Price, Niagara Falls, N. Y., assignor to Union Carbide Company, Niagara Falls, N. Y. Filed July 14, 1904. A process of making calcium carbide consists in preheating a calcium compound and carbon and then electrically heating the mixture.

904,999. BRAKE-SETTING MECHANISM. William A. Rideout, Sr., Oshkosh, Wis. Filed February 24, 1908. An electric circuit includes a magnet to release the valve lever.

905,014. FLEXIBLE SUSPENSION FOR CONDUCTORS. Louis Steinberger, New York, N. Y. Filed September 23, 1907. A cross-arm carries a collar and an insulating sleeve supporting a number of suspension-type insulators.

905,045. ELECTRIC HEATING DEVICE. James I. Ayer, Cambridge, and Horace B. Gale, Natick, Mass., assignors to Simplex Electric Heating Company, Cambridge, Mass. Filed June 13, 1908. The heating element consists of a heat-absorbing body provided with a series of grooves and a ribbon-like current conductor secured in them.

905,048. APPARATUS FOR THE EXTRACTION OF GOLD FROM CRUSHED ORES. Thomas E. Beaumont, London, England. Filed March 29, 1906. An amalgamator forming part of an electric circuit is placed in the base of a vessel in whose upper part is a series of annular electrode plates.

905,066. OUTLET BOX FOR ELECTRIC WIRES. John Fountain, Jr., Elizabeth, N. J., assignor to Sears B. Condit, Jr., Boston, Mass. Filed August 3, 1908. An outlet box has a transverse apertured connector mounted in its wall so as to turn freely in all directions.

905,089. CEILING FAN. Fred P. McBerty, Warren, Ohio, assignor to the Peerless Electric Company, Warren, Ohio. Filed November 20, 1907. Relates to the mounting of an electric motor-driven fan.

905,114. ELECTRIC TRACTION ELEVATOR. De Witt C. Suplee, Philadelphia, Pa., assignor to Suplee Elevator Company. Filed January 3, 1908. The arrangement of a motor-driven cable gear is described.

905,115. ELECTRICAL INTERRUPTER. Henry M. Sutton, Walter L. Steele and Edwin G. Steele, Dallas, Tex. Original application filed September 24, 1904. Divided and this application filed December 2, 1907. Comprises a number of rotatable slotted disks, terminals at the opposite sides thereof and means intermediate each terminal and disk for varying the charging period of the disk.

905,119. INCANDESCENT ILLUMINANT. Orlando M. Thowless, Newark, N. J., assignor to Herbert L. Thowless, Newark, N. J. Original application filed March 8, 1899. Divided and this application filed July 25, 1899. A glower for electric lamps, which is a non-conductor at normal temperatures, but which becomes conductive and incandescent under the action of the current when heated, consists of a mixture of zirconium, thorium and aluminum oxides.

905,126. PRINTING-TELEGRAPH RECEIVER. John Burry, Ridgefield Park, N. J.; Marie Burry executrix of said John Burry, deceased. Filed March 30, 1906. In combination with a lever and a type plate carried thereby, are a number of fulcrums for the lever and electrical means for oscillating the lever on any of the fulcrums.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired December 1, 1908:

464,001. TELEGRAPH REPEATER. R. L. Atkinson, Delaware Township, N. J.

464,005. TREATING FILAMENTS FOR INCANDESCENT ELECTRIC LAMPS. J. Bradley, Massillon, Ohio.

464,025. POTENTIAL INDICATOR. C. E. Kammeyer, Eau Claire, Wis.

464,027. FIELD MAGNET FOR DYNAMOS OR MOTORS. C. E. Kammeyer, Eau Claire, Wis.

464,055. ELECTRIC HEATER. P. Wright, Denver, Colo.

464,063. ELECTRIC MOTOR. M. H. Collon, Denver, Colo.

464,090. ELECTRIC APPARATUS FOR USE ON RAILWAY TRAINS. R. A. Wilder, Cressona, Pa.

464,125. METHOD OF TESTING INSULATED WIRES. R. Varley, Jr., Englewood, N. J.

464,132. ELECTRIC ARC LAMP. Wm. A. Nicholson, New York, N. Y.

464,133. RELAY. R. Varley, Jr., Englewood, N. J.

464,134. ELECTRIC CIRCUIT CLOSER. R. Varley, Jr., Englewood, N. J.

464,136. ELECTRIC REGULATOR. C. W. Holtzer and G. E. Cabot, Brookline, Mass.

464,152. ELECTRIC TRANSMITTING TELEPHONE. R. Eickemeyer, Yonkers, N. Y.

464,156. ELECTRICAL GENERATOR. V. Hirbec, Paris, France.

464,198. ELECTROMAGNET. O. E. Lundstedt, Brooklyn, N. Y.

464,216. ARMATURE FOR DYNAMOS AND ELECTRIC MOTORS. St. John V. Day, St. Louis, Mo.

464,231. ELECTRIC MOTOR. J. R. Robinson, Salem, Mass.

464,244. ELECTRIC FIRE ENGINE. M. W. Dewey, Syracuse, N. Y.

464,245. ELECTRIC HOSE CARRIAGE. M. W. Dewey, Syracuse, N. Y.

464,246. ELECTRICALLY PROPELLED VEHICLE. M. W. Dewey, Syracuse, N. Y.

464,247. ELECTRIC HEATING APPARATUS. M. W. Dewey, Syracuse, N. Y.

464,248. ELECTRICALLY PROPELLED VEHICLE. M. W. Dewey, Syracuse, N. Y.

464,299. ELECTRIC MOTOR. H. A. Florian, Detroit, Mich.

464,347. MAGNETO-ELECTRIC IGNITER FOR COMBUSTIBLE-VAPOR ENGINES. L. G. Woolley, Grand Rapids, Mich.

464,470. ELECTRIC ELEVATOR. W. Baxter, Jr., Baltimore, Md.

464,475. JOINT FOR ELECTRIC CONDUCTORS. H. W. Fisher, Pittsburg, Pa.